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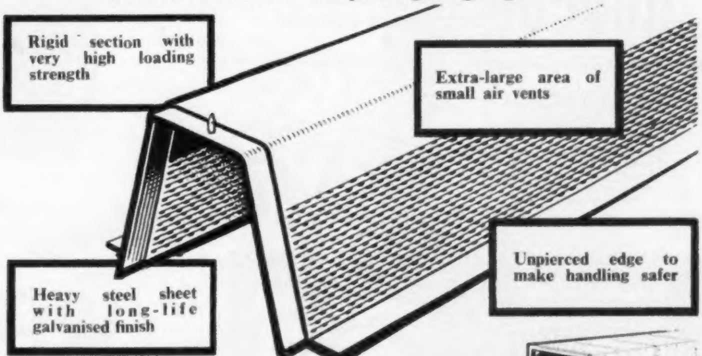

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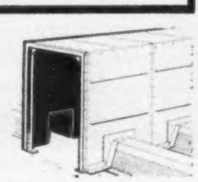

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Editorial Offices
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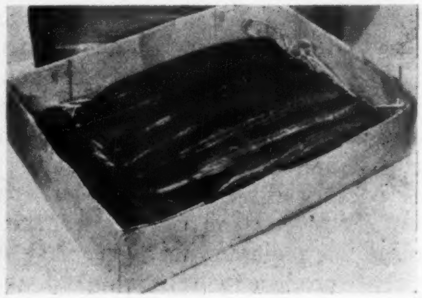

Statutory Grading for Horticultural Produce

HORTICULTURAL marketing in Britain will take a firm step forward when statutory grading is introduced in 1967–68 for the first five commodities—apples, pears, cucumbers, tomatoes and cauliflowers. Its primary object will be to help home producers to compete more effectively with imported produce, much of which is already graded to internationally recognized standards. Regulations laying down national statutory grades for each commodity and labelling requirements will be made with Parliamentary approval under the Agriculture and Horticulture Act 1964. They will apply to both home-grown and imported produce sold through wholesale channels. It is intended to bring them into force on the following dates:

Apples, Pears	17th July, 1967
Cucumbers	15th January, 1968
Tomatoes, Cauliflowers	13th May, 1968

Eventually it is hoped to introduce grades for a wide range of fruit, vegetables and flowers.

The grades for each commodity consist of a range of four classes, namely, Extra Class, Class 1, Class 2 and Class 3 (the compulsory minimum grade), and specify a number of requirements relating to colour, size, shape, cleanliness, blemishes, etc. They are based on the present European standards for international trade with appropriate modifications to suit the needs of the domestic market and to take account of the fact that the grades will be checked at the wholesale point and not at the point of dispatch. Once the regulations are in force all regulated produce sold through wholesale channels will have to meet the requirements of one or other of the four classes and be labelled accordingly. It will not be necessary for growers or packers to use all the classes. It will be entirely up to them to decide which class to claim for their produce, but they must ensure that the produce meets the requirements of the class that is claimed for it.

The produce will be checked at all wholesale points. These include wholesale markets, individual wholesalers' premises, grower-wholesalers' premises, packing stations, and depots for chain stores and supermarkets. Checking will be done by sampling consignments selected at random. Any produce that is found to be below the class claimed on the label will be down-graded. The sale of produce that fails to meet the requirements of Class 3, and of unlabelled produce, will be prohibited except in certain specified ways. The only sales to be exempt from the grading requirements will be the following:

(*a*) sales by retail (the grades are not capable of application to small quantities);

(*b*) sales for export (the produce would then have to conform to any requirements of the importing country);

(*c*) sales for processing;

(*d*) direct sales by the producer to a person who undertakes to grade and label the produce before reselling it;

(*e*) direct sales by the producer where he himself delivers it to the shop or store from which it is to be resold (Ministers have powers to remove or limit this exemption by order).

Enforcement of the regulations will be carried out by officers of the newly-formed Horticultural Marketing Inspectorate who are receiving extensive training for the task at the Ministry's training centre in London. It is envisaged that the inspectorate will be built up to a total strength of about 170 by the end of 1969.

It is hoped that growers will try out the grades before the regulations come into force. Guides to the interpretation of the grades will be made available as soon as possible. There will be a trial period starting next August during which consignments of the five commodities selected at random on wholesale markets will be examined by the inspectors. The standard will be assessed in relation to the proposed statutory grades, and during this trial period growers or packers will be informed of the class attained by the produce examined. The trial assessment will continue for each commodity until statutory grading begins.

The quality of British produce is second to none, and the grower is fortunate in having a market for it on his own doorstep. Nevertheless, home-grown produce does not always come off best in competition with well-presented and well-graded imports. The only way to secure further improvement is for all growers selling through wholesale channels to grade their produce, and it will be in their own interests to make the best use of the national statutory grades when these are introduced.

The June Returns One Hundred Years Old

Edgar Thomas

THIS year the annual census of British farming attains its first centenary. Censuses of agriculture are of great antiquity for they go back to the earliest years of chronicled history. For example, records survive of a cadastral survey of Babylon in the third millenium B.C.; the Bible tells us about the agricultural enumerations carried out by the Hebrews; our own Domesday Book was essentially a census of the agricultural resources of medieval England.

After Domesday

After Domesday there was to be a long wait of some six hundred years before the next attempt to make a nation-wide appraisal of agriculture. In 1688 Gregory King compiled his famous tables giving the acreages of the chief categories of land together with estimates of the values of the crops and the livestock of the country. The eighteenth century saw several attempts to meet the need for agricultural statistics, culminating in the county surveys of the first Board of Agriculture under Sir John Sinclair and Arthur Young at the turn of the century. With the disbanding of the old Board in 1821 the demand for official statistics was voiced by many enthusiastic advocates. It received a new impetus from the founding of the Royal Statistical Society in 1834 and the Royal Agricultural Society of England in 1838. Official support was also forthcoming especially from the old Board of Trade. But thirty years were to pass before success was attained. They were years of determined resistance from landlords and farmers as well as from parliament.[1] The antagonists regarded all forms of official returns as inquisitorial and an infringement of privacy, and they feared that statistics would be used to increase taxes. In short, they shared in full the suspicion of censuses of all kinds which is almost a tradition of people the world over.

An important date

In the 1830s the Board of Trade initiated experiments to collect farm statistics in selected districts. In 1847 the vice-president of the Board introduced a bill 'to make provision for the collection of Agricultural Statistics in England and Wales' but the bill failed to secure a second reading. In 1855 a Select Committee reported in favour of the collection of returns, but again a bill to implement the recommendation had to be withdrawn. This was also the fate of a later bill introduced in 1857 by (Sir James) Caird and Garnett. Caird, however, kept up the struggle and in 1864 he carried a resolution in the House of Commons 'that in the opinion of this House the collection and early publication of the Agricultural Statistics of Great Britain would be advantageous to the public interest', and the following year the Government agreed to give effect to this resolution. In 1866 this undertaking was honoured when the first national agricultural census was launched. In this first count two sets of returns were made—one in March for livestock and one in June for crops. In each of the next ten years both livestock and crop returns were collected together on the 25th June. In 1877 the census date was altered. Ever since, the given day for the taking of an instantaneous statistical picture of the 'national farm' has been the 4th June each year. This has long become an important date in the farming calendar.

Collecting the returns

Over the years there have been changes in the routine of organizing the census and there have been changes in both its coverage and content. It was the Board of Trade which was responsible for the first census in 1866, although the actual collecting was carried out by the local excise officers of the Board of Inland Revenue. In 1883 responsibility passed to the 'Agricultural Department' of the Privy Council where it remained until the establishment of the new Board of Agriculture in 1889. The excise officers continued, however, to do the collecting up to 1919 when the Ministry of Agriculture and Fisheries (as it had by then become) appointed some 300 part-time Crop Reporters of its own to do the work. Since 1949 these Crop Reporters have, in turn, been superseded by the staff of the Ministry's Agricultural Census Branch working in association with the District Officers of the National Agricultural Advisory Service. This arrangement permits a desirable combination of central control with adequate local supervision.

Three changes have been made in the basis of collecting since 1866 when returns were made for holdings of 5 acres and above. In 1867 this lower limit was abandoned; between 1869 and 1891 a lower limit of ¼ acre obtained; since 1892 the rendering of returns has applied to the occupiers of all holdings of more than one acre used for agriculture.

From the start the returns have been distributed and collected by post. From time to time there has been talk of changing from the 'mailed questionnaire' to the 'enumerative' system which is used in many countries abroad. But our method appears to have worked well and cheaply. It rests heavily on the maintenance of a complete and always up-to-date list of all the holdings in the country. The current list contains over 320,000 entries —one for every known agricultural holding in England and Wales. Keeping the list up to date requires the tracking of all holdings falling out of or entering farming use as well as changes in the occupiers of existing holdings.

This is a very difficult task. But the existence of a central register of all holdings can serve many purposes quite apart from being the corner-stone of the census structure. It fully justifies keeping a substantial staff simply to maintain it.[2]

One of the more important administrative changes has been the change from a voluntary to a compulsory means of obtaining the returns. Up to 1926 all returns had been made voluntarily, except in the years from 1918 to 1921 when they were compulsory under the Corn Production Act 1917. When this Act was repealed in 1921 the returns again became voluntary, only to be made compulsory once more with the passing of the Agricultural Returns Act in 1925. It has been claimed that under the voluntary regime less than three per cent of the occupiers in the whole country ever refused to complete the returns.[3]

The war and after

The outbreak of war in 1939 made it imperative to have more frequent and more searching statistics to speed the Food Production Campaign. The wider powers for the collection of statistics given under the Agricultural Returns Order 1939 and other war-time regulations led to many changes. Some of these changes have become permanent and they are reflected in Sections 77 to 81 of the Agriculture Act 1947 which now govern the collection and use of official agricultural statistics in this country. The 1947 Act empowers the Minister to make regulations for the service of notices on occupiers requiring them to provide written information on certain prescribed subjects. The information is required not only for the purposes of the Annual Price Reviews but also 'for the general planning of the industry and the Government's periodical economic surveys'. The 'prescribed subjects' have a very wide scope, but no occupier can be required to provide a balance sheet or a profit and loss account.

Sample and special censuses

The familiar June Return continues to be the centre-piece of the census structure. It has to be completed by all occupiers. In addition to the June Return, however, the quarterly returns introduced during the war years have remained, but they are now collected on a one-third sample basis. In any one year, therefore, each occupier completes two census forms—one in June and the other at one of the other quarters, i.e., March, September or December. The latter covers items of agricultural machinery as well as livestock and labour items. There are also special censuses—two a year for glasshouse crops, two for vegetables and one every five or six years for orchard fruit. All these returns are compulsory and 'penalties may be imposed for failure to make a return or for knowingly or recklessly furnishing false information'.

It may be true that farmers have come to accept the obligation to meet the demands of Government for more and more facts and figures about their industry. But it is also true that there is a limit to their capacity for answering census questions. A nice balance has to be kept between the two. The Agricultural Statistics Advisory Committee set up by the 1947 Act helps the Minister to do so. This committee has representatives of farmers, landowners and farm workers and it advises on the nature of the returns to be made. Every proposal for adding to the list of questions is subject to the

scrutiny of the committee. The need for such a scrutiny is dramatically underlined by the mounting number of questions in the main census schedule. It has increased from about 20 in 1866 to over 150 today, although many of today's questions apply only to specialist producers.

Processing the returns

The heavy task of checking, sorting, assembling and processing the schedules is now carried out by the Statistics and Data Processing Divisions of the Ministry at Guildford. Here the individual returns are consolidated into parish totals which, in turn, are grouped to give county and national totals. The individual returns are confidential and there is a statutory ban on their disclosure for other than official purposes. The parish totals are not published, but these can be consulted by bonafide research workers. Preliminary national totals usually appear in the public Press some two months after the census date. This timely release means that the statistics are available for use by those who need them for forecasting and for business purposes. Government departments, food processors and manufacturers, marketing boards and the like are all users of the statistics.

The definitive county and country totals are issued in due course as an addition to the annual volumes of agricultural statistics which have been published since 1866. These volumes constitute an unbroken record of our farming story. Historians, economists, geographers and other researchers will long continue to find them a rich quarry for their studies. The tables they contain mirror a hundred years of the ups and downs in the total acreage of farm land, in the crop acreages and in the livestock numbers of every county in England and Wales. Those who use the tables need, however, to be wary if they are to avoid the pitfalls left by the many changes in definitions and in categorization made from time to time in compiling them. The progressive improvement in the coverage and accuracy of the census itself should also be borne in mind and, in particular, the figures for the earlier years must be treated with caution.[4]

Later developments

In spite of their array of facts and figures the volumes of *Agricultural Statistics* have, up to now, told us all too little about the *structure* of the industry. No one doubts the value of an annual stocktaking of the crops and livestock on the 'national farm'. But these crops and livestock are actually grown and kept on many thousands of separate farm units. How many units are there and what are their sizes? How many farms grow the different crops and keep the different types of animals? Above all, how many are there with different mixes of crop and livestock enterprises? These are questions to which answers must be given if any kind of economic planning is to proceed in a meaningful way.

The census schedules contain much of the basic material for giving the answers. But using them for this purpose was too formidable a task so long as the processing of the material in the schedules had to be done by hand. The application of scientific sampling and the use of punched-card equipment and the electronic computer have now revolutionized the task and a break-through has already been made. This has been directed to a more searching analysis of the data on numbers and sizes of farms which

is the starting-point to any study of the business structure of the industry. Hitherto, the tables giving the numbers of holdings in size groups in *Agricultural Statistics* relate to the numbers of returns tabulated. They do not represent the numbers of *farms* in the sense of separate business units. There have been many attempts, none entirely satisfactory, to deduce the numbers of bonafide farms from the crude figures in these tables. Automatic data processing has now, however, made it possible to do so by applying a new system of classifying the returns on a sample basis according to the 'standard labour requirements' of the individual holdings.[5] Such a classification goes a long way towards answering the deceptively simple question —how many farms of different sizes are there in this country? Without this it would not have been possible to state in the White Paper on the 1966 Price Review that there are some 220,000 full-time farms in the United Kingdom. Of these about 112,000 are small-scale farms, 66,000 are small 'commercial businesses' and 42,000 are large 'commercial businesses'.

The future

It is safe to predict that this is only the first of many studies of the structure of farming which it is now possible to make by subjecting the June Returns to scientific sampling and automatic processing. Pressing on with such studies is the best possible way of celebrating the first centenary of our agricultural census.

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Professor Edgar Thomas, C.B.E., B.Litt., B.Sc., was, before his retirement in 1965, Professor of Agricultural Economics at the University of Reading.

Vining Peas

and

Dwarf Beans

A. J. Gane

OF all the vegetables grown for canning, quick-freezing and dehydration, peas are the most important. At the same time the mechanization of dwarf bean harvesting has resulted in a dramatic rise in the acreage of this crop also. Two-and-a-half thousand acres of dwarf French beans were grown in this country in 1956; by last year the total had increased to nearly eight thousand. These large-seeded legumes are useful sources of vegetable protein and serve as additional break crops. They are valuable not only because they extend the rotation but also because of their nitrifying properties. They are crops grown on contract, for an assured market.

Vining peas

In the last twenty years a great deal of research has been carried out on a wide range of aspects of pea growing. This has been spurred on by the

increasing need of the grower for efficiency in crop production and of the processor for reliability of supply of raw material. Peas can be grown successfully on most soils. Early ploughed land which has had ample opportunity to break down through the action of rain, frost and wind during the winter months and which can therefore be reduced to a reasonable tilth with a minimum of cultivation in the spring, provides the ideal preparation. Its use obviates the unnecessary compaction which so often occurs after excessive wheelings and which suppresses seedling development to a marked degree. In addition, the few preparatory cultivations required enable drilling to begin earlier than would otherwise be the case—and there is no substitute for an early start.

Fertilizers

The manurial requirements of peas are small, but a reasonably accurate idea of soil fertility is nevertheless essential if fertilizer is to be applied to advantage. Potash is the most important of the three main nutrients, 120 units being required on soils which are very deficient. There is less demand for phosphates, and the maximum needed is 40 units where soil phosphates are very low. The need for a small quantity of applied nitrogen is generally confined to early sowings which are being made after a prolonged period of excessively wet weather. The balance required between potash and phosphate in the fertilizer is dependent on the fertility of the soil, as shown by analysis, and the rate of application is dependent both on soil fertility and the method by which the fertilizer is to be applied. The appropriate manurial recommendations are available in tabular form.

Varieties

Nearly four hundred varieties of peas have now passed through the screening trials at the Pea Growing Research Organisation's Research Station at Yaxley. Further jointly-planned trials of the more promising ones among them have been carried out by the Pea Growing Research Organisation, the Fruit and Vegetable Preservation Association and the National Institute of Agricultural Botany. The varieties are assessed for agronomic characteristics and for their quality. Differences between varieties in their degree of susceptibility to pea wilt (*Fusarium oxysporum f. pisi*), downy mildew (*Peronospora viciae*) and pea early browning virus have also been the subject of P.G.R.O. field experiments which have met with marked success. Pea wilt is a persistent, soil-borne, fungus disease which is generally associated with over-cropping; its effects are frequently devastating and may cause entire loss of crop. Downy mildew, on the other hand, is a more common though generally less severe disease, which is worse in wet seasons than in dry, causing both yield reduction and loss of quality. Over sixty varieties have now been studied in relation to these diseases, and the results have recently been published in leaflet form. Varietal resistance to disease is an invaluable aid in crop production.

There are many factors to be taken into account if the selection of varieties for commercial use is to be made to the best advantage, and for this reason the P.G.R.O. continually encourages its supporters to discuss their requirements with the staff at Yaxley. Advance information about new varieties, their characteristics and resistance to diseases is clearly best considered in

the light of twenty years' experience of pea growing and of the conditions to be found in the districts involved.

Yield

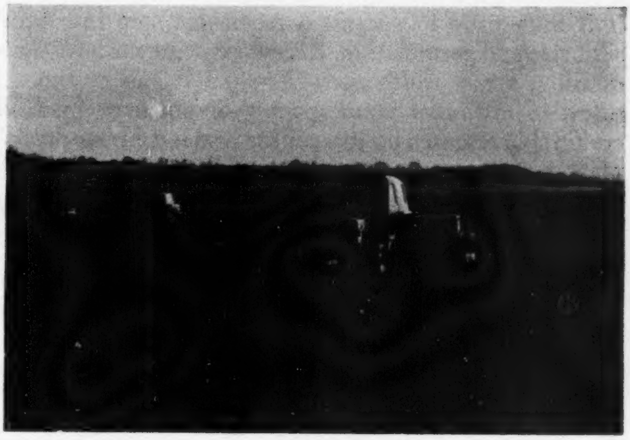
The optimum combination of row width and plant population, and the relationship between plant population and seed rate, have been closely studied and have been found to influence greatly the amount and reliability of yield and the monetary return. In experiments with vining peas the yield from peas sown in rows eight inches apart was found to be 24 per cent higher than from those sown in rows sixteen inches apart. There was no evidence to suggest, however, that even narrower rows would consistently give still higher yields. Plant population also greatly affects the yield of peas and must be carefully considered by those who strive for high-yielding crops.

The size of pea seed varies, especially between varieties, between samples of the same variety, and between years. Investigations have shown that seed and seedling losses vary greatly too, according to the time of year when sowing takes place and the soil type. Laboratory germination also varies between samples. Variations of as much as 25 per cent have been recorded at Yaxley in the size of seed in different samples of the same variety. Differences in survival of peas of the same sample have been found to vary from 25 to 5 per cent as the season progressed and as conditions became more favourable. These variables are cumulative. At one end of the scale we have the sample of comparatively low laboratory germination, of large size and for early sowing, and at the other we have the sample of high laboratory germination, small size and for late sowing. The use of a common rate of seeding clearly results in vast differences in plant populations, and frequently accounts for fluctuating yields.

Once these facts are appreciated they can be used to considerable advantage, since by taking them into account it is possible repeatedly to achieve the optimum population or very near the optimum, under field conditions. P.G.R.O. work on this subject has extended over a period of twenty years and throughout the main pea growing areas. A detailed practical interpretation of the results has recently been published in the form of an advisory leaflet.

Chemicals and mechanization

Weeds are of importance in peas not only because they reduce yield, but also because they impair the efficiency of cutting and vining. Weed fragments mixed with the produce are often difficult and expensive to remove, and juices which are released from them in the vining process may cause off-flavours. The post-emergence application of dinoseb-amine has long been the standard treatment for the control of annual broad-leaved weeds in peas but while this remains the position at present, prometryne has now been approved for use in this crop. It has been extensively tested by the P.G.R.O. over a period of years in three distinct types of trial. It gave good results when applied pre-emergence on all soils except those containing a high proportion of organic matter, by which it was adsorbed, and those containing a high proportion of coarse sand, where crop damage resulted. Dinoseb-amine is well known to be comparatively ineffective when applied in cool weather and its control of knotgrass is usually poor. Prometryne,



Early ploughed land which can be reduced to a reasonable tilth with a minimum of cultivation is ideal for the sowing of peas in March. Once over with the spring-tine and then the drill

however, is much less dependent on temperature and gives good control of knotgrass as well as mayweed, annual nettle and annual grasses. A great deal of effort has been applied to the control of wild oats in peas, and details of P.G.R.O. trials with the latest and most efficient material for this purpose appeared in *Agriculture* in February this year. Developments in mechanization continue with increasingly automated static viner systems, with the use of more mobile viners and with the reality of the pea pod harvester.

Dwarf French beans

Dwarf beans are thought to require, ideally, an open, loamy soil, well supplied with organic matter, quick to warm up in spring and early summer, well aerated and yet retentive of moisture. The precise manurial requirements are not yet known, but in a number of factorial experiments carried out by the P.G.R.O. last season, applied nitrogen gave marked increases in yield, whereas the effects of phosphate and potash were very limited indeed. These experiments will, of course, be repeated for some years and are in themselves insufficient for firm conclusions to be drawn. On the basis of earlier work it is fair to assume that dwarf beans will benefit also from the sideband placement of fertilizer, at least while they are grown in the comparatively wide rows demanded by present-day harvesters.

For mechanical picking, dwarf beans should be upright and compact in habit, bearing their beans well up the stem and clear of the ground. A reasonable amount of foliage is an asset in that it helps to minimize the bruising of beans by the tines of the harvester. These and many other factors are taken into account when beans are assessed in the two series of variety trials conducted annually by the P.G.R.O.

The seed

Dwarf bean seed is very fragile and must be handled with care. A bag has only to be dropped on a hard surface for seed coats to be cracked, and even this apparently slight damage will be reflected in germination. Fungicidal seed treatment should, of course, be a matter of routine, and at least in some districts it is wise to use a combined fungicidal/insecticidal material in order to control both soil-borne diseases and bean seed fly. The seed is generally sown 2–2½ inches deep, but as in the case of peas

it is unrealistic to suggest a particular seed rate because of variations in seed size and germination. Recent experiments have indicated the advisability of using a row width no wider than 16 inches and a seed rate which will result in intra-row plant spacing of no more than 4 inches. P.G.R.O. is continuing research on this subject and it is highly probable that the optimum plant population is still greater and that more even distribution of plants will bring about additional increases in yield. It is anticipated that the mechanical difficulties involved in harvesting crops grown in this way will soon be overcome.

Chemicals and irrigation

Dinoseb-amine and dinoseb in oil are at present the herbicides generally used for this crop, where they must only be applied pre-emergence. Control of seedlings by the pre-emergence application of contact herbicides such as the diquat-paraquat mixture is also occasionally practised. Halo blight is one of the most serious diseases. It is seed-borne, and in humid or wet conditions it spreads rapidly, causing damage and sometimes death. The use of seed from arid regions reduces risk of importing infected seed. Where outbreaks do occur, plants in heavily-infected areas should be pulled and burnt and the remainder of the crop should be treated with a copper fungicide. Runner beans harbour the disease but tend to be less affected by it. Dwarf beans should therefore be sown at some distance away from them. Irrigation of dwarf beans has proved to be of little value before flowering, but during flowering and the early stages of pod production very worthwhile increases in yield can be obtained.

New research station

The P.G.R.O. specializes in research and the provision of information and advice on all aspects of the production of peas and beans for processing. This year will see the establishment of its new research station which is under construction at Thornhaugh, Peterborough.

This article has been contributed by **A. J. Gane, C.D.A., F.R.M.S., F.R.S.A.,** who is Director of Research at the Pea Growing Research Organisation's Research Station at Yaxley, Peterborough.

Cwmhesgyn Sheep Farm

K. J. Price

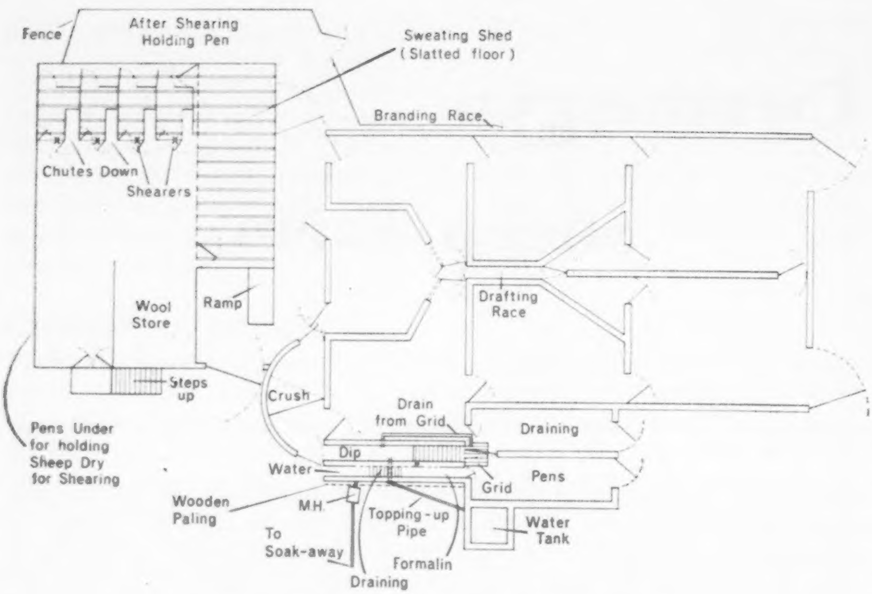
SINCE time immemorial Welsh Mountain sheep have grazed the hill and have been handled and sheared in the pens by the shepherd's house at Cwmhesgyn, in the heart of the mountain. Four or five times a year the sheep were gathered in for various operations such as earmarking, washing, shearing, dipping and sorting. The pens were built of stone and the only method of sorting sheep was to catch them individually by hand and move them into their appropriate pens. Large numbers of strong neighbours were required and they had to walk up to Cwmhesgyn which has no road leading to it.

The big event of the year was shearing day and it always took place, weather permitting, on the Wednesday before the last Saturday in June, when some eighty people would congregate at Cwmhesgyn. These were all ages and sexes, and they came from near and far. Some were invited and some were not, but most came because their fathers and grandfathers had always come before them. About forty of the most experienced shearers would sit down at the benches, and some of the strongest would spend the day carrying sheep from the pens and putting them down in front of the shearers. The older men would be wrapping the fleeces and packing the wool sacks, while others would be stamping the sheep, picking up the clippings, organizing the sheep in the pens and doing a hundred-and-one other jobs. The children, who always had a day off from school for the occasion, would be running around with linen strips with which the shearers tied the sheep's legs together. The women were busy preparing tea and the two or three meals which would be consumed during the day.

In this way each shearer managed about thirty-five sheep a day. Of course, a good hand clipper could shear twice as many a day, but thirty-five was about the average. After all, time was not all that important and it really was more of a day out than anything else. If it rained the whole performance was repeated next day and so on, with further supplies of food having to be carried up the mountain.

The new order

The old order had to change. Time somehow seems more important now that the machine has taken over from the hand shearers. The new generation have other things to do than shearing their own and their neighbours' sheep



Shearing shed and sheep handling pens at Cwmhesgyn

day after day for a month. We could not get that amount of labour now, nor could we afford to pay for it or spend so many days shearing for our neighbours in exchange. So all is changed. New pens, built of grey concrete bricks, and a shearing shed have gone up by the road on the edge of the mountain and now the sheep come down to the shearers.

When we first decided to construct new sheep pens and a shearing shed at Cwmhesgyn we had great difficulty in obtaining any suitable plans in this country, but Australian and New Zealand friends were full of ideas. We picked their brains to the full and the main pattern for both pens and shed came from the other side of the world. We had great fun picking out what we thought were the best ideas, joining them all together and adding lots of gadgets and refinements of our own invention.

We have more sheep now at Cwmhesgyn than in the old days but they are handled in half the time and with a quarter of the labour. The men and dogs still have to gather the mountain in the same way as they have always done, but once in the pens the sheep do almost all the work themselves. To sort them out they are driven through the race and with one hand the shepherd moves the gate to divide them three ways. In order to make it easier we put a different-coloured ear-tag in each age group so it is a simple matter to pick out the draft ewes or shearlings or whatever may be required. When the sheep are running fast it needs a clear head and a steady hand to draft three ways. To inject the sheep we run them up an inclined ramp one at a time on to a raised platform so that the shepherd does not have to break his back by constant bending down.

Dipping

We can dip at the rate of five hundred an hour by driving the sheep into our semi-circular crush pen. A ratchet prevents the gate being pushed back

and inclined rollers leading into the bath save a lot of pushing and shoving. Two draining pens, each the same size as the semi-circular pen, mean that the sheep have plenty of time to drip and very little dip is wasted. The dip is filtered before re-entering at the centre of the bath; thus it does not flow back into the sheeps' faces as they leave the bath. The reserve water tank with a big outflow means that the bath can be topped up with no waste of time.

Two foot baths, the first containing water and the second formalin, are sited alongside the dipping bath; when the movable wooden hurdles are in place we again use the semi-circular crush pen, and the sheep wait awhile afterwards in the draining pens to give the formalin a chance to work. The draining and crush pens are the only concrete areas we have; the floors of the rest of the pens are of free-draining gravel. Concrete very soon becomes slippery, the sheep fall down, and in no time at all they are in a mess.

Shearing

The shearing shed is built on two levels so that we can keep sufficient sheep overnight, underneath the shearing floor, for a day's work. This makes us quite independent of the weather. From here the sheep are driven up an incline to the slatted floor sweating pen, and thence down a passage and into the four catching pens. Now all is ready for the four shearers. During the day each man shears about 150 sheep. There is a man who wraps the wool and throws it into a huge bin where it piles up to the roof, and another who keeps the sheep moving. After shearing the sheep leave the shed by four chutes down to an outside pen, go into the branding race where they are stamped with our mark and then away back to the mountain. Some time later the wool merchant grades the wool; each grade is packed into separate wool sacks and it is off our hands.

So the old-style shearing day, with all its gossip and joking, has gone for ever. Now we fix a week that suits us, generally about the middle of July when the hill sheep shear better, irrespective of the weather, and six men finish the lot in three or four days. The old stone pens and the shepherd's house on the mountain are silent and deserted, but the sheep still tread the same old mountain paths.

'Ond bugeiliaid newydd
Sydd ar yr hen fynyddoedd hyn'.

('Shepherds come and go but the mountains go on for ever'—from an old Welsh song)

The author of this article is **Lt. Col. K. J. Price, D.S.O., M.C.**, who farms 650 acres and a large mountain in Merionethshire.

Grassland Improvement on Yorks/Lancs Pennines

John Jones

FEW parts of Britain offer a more austere background for farming than the Lancashire/Yorkshire Pennines. Yet thousands of farmers compel a living from this harsh environment. Though they differ in the way they deploy their resources, all depend upon livestock for their income and rely upon pasture and conserved grass to supply a big proportion of their stock feed. Raising sheep and store cattle is the chief activity on the higher farms, though many carry small dairy herds as well. Intensive milk production with some retailing occupies farmers at lower levels near industrial towns.

Pennine herbage varies within the wide limits of the natural rough grazings on the open moorland and the cultivated grasses and clovers which are to be found in the better pastures and meadows. Farm size, which may range from below fifty to several hundred acres, conveys little impression of the extent of a business owing to the great differences which occur in the land's stock-carrying capacity and the level of management it receives. By most standards incomes are low, and for the amounts of skill, energy, capital investment and risk involved they compare unfavourably with those obtained from lowland farms.

Problems

Here, as elsewhere, the first concern of the grassland farmer is to match the numbers and kinds of his livestock to the carrying capacity of the farm. In so doing he must allow for irregularity in the seasonal pattern of grass growth and the need to conserve herbage from spring and summer production for feeding as hay or silage during winter. Pennine winters are long and sometimes severe. Hence it is essential to have sufficient fodder in store to meet all likely needs until grass is ready to graze again in May.

High altitudes, poor aspects and a paucity of shelter expose land and livestock to the full force of bad weather. As a result the growing season is short and sheep losses during a severe winter can be high. In many places poor drainage, steep slopes, and the presence of deep gullies, ravines or rock make access and cultivations difficult, if not impossible. Moreover, some water boards impose restrictions on the cultivation, manuring and grazing of land over which they have control. High rainfall, though good for the growth of grass, exaggerates bad drainage conditions and emphasizes poaching risks. In addition, it leaches nutrients from soils that are already acid and low in mineral fertility. Haymaking is often a difficult, catchy and protracted operation.

Production from the open moorland is low and for much of the year the herbage is poor nutritionally. The communal nature of the pasturage is an additional obstacle to cultivations even if they are physically and economically possible. Utilization of this type of grazing is, therefore, confined to the hardiest but less-productive types of stock. The immediate effect of ploughing and reseeding some enclosed poor hill pastures has been dramatic. But some of the benefits from this operation were quickly lost by failing to repeat lime and fertilizer applications, by stocking heavily when the land was wet and by not stocking adequately at other times.

Effective grazing control is frequently prevented by broken walls and the large size of many hill pasture fields. Repairs to existing fences and the erection of new ones, though essential, can be costly. Sufficient capital is commonly lacking to equip farms for the most advantageous management. Modernization of farmhouses and buildings is also an urgent need on many holdings.

Choice and treatment of land

Choosing which piece of land to tackle and deciding what to do with it are important aspects of improvement. The condition of the land, the requirements of the stock, the feasibility of carrying out a proposed treatment and the cost of doing the work all have to be carefully considered before starting an expensive operation. It has to be remembered that if the application of more fertilizers and better all-round management of existing pastures and meadows will supply the needs of livestock, this can be more profitable than attempting a costly reseeding or renovation. Furthermore, a high potential for improvement is not sufficient justification for tackling a difficult or expensive renovation if livestock to eat the extra grass cannot be obtained.

Better drainage, better grazing and mowing practices, the greater use of lime and fertilizers, and the control of weeds like soft rush, creeping buttercup and bracken, all help to increase the yield and quality of grass. Productivity is also raised by more effective use of the herbage. Better grazing and mowing

practices sometimes mean erecting new fences or repairing broken ones, increasing stocking rates, mixed grazing by cattle and sheep, or the alternation of grazing with mowing where this is practicable. Fields carrying a poor type of herbage that does not respond sufficiently to better general management must either be ploughed and reseeded or be renovated by other drastic treatments. To reduce dependence on purchased feedingstuffs, many thousands of poor acres in the Pennines have been ploughed and reseeded during the recent past.

Very poor land in the Pennines has sometimes needed a year or so under pioneer crops before it could be reseeded to a long ley or permanent grass. Where ploughing was impossible or undesirable, a few successful renovations have been undertaken with the help of grass-killing chemicals like dalapon and paraquat followed by rotavations or some other form of surface cultivation and reseeding. The total effect of reseeding and surface treatment has been to provide all classes of grazing stock with an enormous amount of good pasture grass and fodder. Amongst those to benefit most were small dairy farms near industrial towns in Lancashire and Yorkshire. Moreover, grass both helped to save purchased feed and enabled more cows to be kept.

Two examples of schemes completed in 1965 on stock-raising farms in the Pennines are set out below. In both cases the costs are shown and the benefit from different kinds of improvement is indicated.

SCHEME A

Renovation of 32 acres of poor grassland

Costs	£	*s.*	*d.*
Materials (net)			
96 tons gr. limestone 19·2 tons basic slag (10% P_2O_5) 3·2 tons compound fertilizers 16 gallons MCPA spray	189	12	0
Application of fertilizers	26	8	0
Cultivations			
Mowing rushes Removing trash Spraying rushes Harrowing twice	131	4	0
Total	347	4	0

The farmer qualified for a grassland renovation grant of £128 which reduced his net cost per acre to £6 17*s.* 0*d.*

During the year before treatment the land carried three cows for 17 weeks and gave 800 ewe-weeks of grazing. In 1965, thirty cows and their calves pastured for four weeks. 736 ewe-weeks grazing were provided and about 15 tons of hay were cut. Continuing the better standard of manuring and general management will maintain the improvement in pasture quality and the increased productivity achieved so far. Benefits resulting from a higher density of stocking will enable the farmer to recover all his costs and obtain a net increase of income by the third year. Even without assistance from the grassland renovation scheme, which is to be discontinued on 31st August, 1966, the costs probably would be extinguished by the fourth or fifth year.

SCHEME B

Ploughing and reseeding of 7 acres of poor grassland

Costs	£	*s.*	*d.*
Materials (net)			
21 tons gr. limestone 3½ tons basic slag (14% P_2O_5) 14 cwt compound fertilizer 10½ cwt Nitro-Chalk Grass and clover seeds—with rape and turnips @ £6 10*s.* per acre	107	0	10
Application of fertilizers	7	14	0
Cultivations (completed June, 1965)			
Mowing rushes Ploughing Removing stones Discing 5 times Harrowing twice Sowing seeds Rolling	113	8	0
Fencing			
(5-year life)	4	0	0
Total	232	2	10
Less ploughing grant @ £12	84	0	0
Net cost	148	2	10
Net cost per acre	21	3	3

Before treatment the 7 acres provided about 500 ewe-weeks grazing annually. In 1965, after treatment, grazing was supplied for 150 lambs from 3rd October until 11th November when they were sold fat at an average price of £5 each. Without this extra keep the lambs would have been sold as stores. The farmer estimated their value on 3rd October to have been £3 15*s.* each. In addition the crop was grazed from 12th November for a further period of five weeks by 35 gimmer lambs. The new sward is now in excellent condition and with good following management should remain very productive for many years.

Haymaking

Haymaking, despite its hazards, is preferred to ensilage by most Pennine store stock farmers, who regard the latter as a laborious process. Bigger yields of better quality fodder are needed. Meadow land on hill farms is required by lambing ewes until late spring, and this adversely affects both the yield and quality of the hay crop. Moreover, the liberal use of nitrogen, which would help to increase production, is widely deprecated as it delays the hay-drying process. A moderate usage of nitrogen coupled with better haymaking techniques, however, could yield more and better hay. Barn hay drying, which has much to commend it for some conditions, is gaining popularity in certain districts. Ensilage, which permits a greater usage of nitrogen and more intensive grassland management, generally encourages higher yields of conserved feed and assists production from pastures. For these reasons the process is particularly valuable on milk farms.

Livestock management

After allowing for any grants or subsidies that the work may attract, the cost of improvement on all-grass farms must be borne by increased returns from livestock. This is done in one or more of three different ways:

1. By carrying more stock and so increasing the annual sales of livestock or their products.
2. By taking animals to a better standard of finish before sale. (Growing a catch crop or top dressing aftermath enables lambs to be fattened for the butcher before autumn as an alternative to selling them in the store market.)
3. By saving on purchased feed.

Since the productivity of hill land depends so largely upon sales of livestock and their products, it is essential to integrate effectively the skills of cattle and sheep management with good grassland husbandry. More and better grass for both grazing and conservation will permit more stock to be kept on the hills, and this should lead to increased sales of suckler calves, store cattle, lambs and draft ewes.

Calving during December to February and creep feeding for four to six weeks before the autumn sales are two of the conditions necessary for the production of well-grown suckler calves that will attract the higher prices. Ewe and lamb losses in some hill flocks appear to be unduly high, reaching ten per cent or more annually. Better general flock management and disease control would prove beneficial. On the basis of each animal representing about £4, this would lead to much better profits at the end of the year.

The provision of more spring grazing, where this can be done, would help farmers to support a bigger proportion of twin lambs which at present many do not want. This could have the effect of raising the lamb crop on individual farms from well below 100 per cent to something well above this level. Hand feeding of hay and/or concentrates to hill flocks as the ewes approach lambing is being accepted by more farmers as sound flock management. In some cases molasses is being used for this purpose, and for a cost of about 5*s*. per head the practice has had various beneficial effects including a reduction in flock losses.

As renovation costs must be reimbursed through increased returns from livestock, the preparation of a budget before starting work is important. This will indicate both the probable profit margin and any additional capital that may be required for necessary stock purchases to consume extra grass.

The two cases described illustrate that reseeding and renovation on very poor hill land can bring marked increases in grass production, and that the recovery of all, or a large part, of the expenditure is possible even within the first year. With suitable following management, the unexhausted value of the improvements should last for several more years. Reseeding and renovation, coupled with better general management of grassland and livestock, can help Pennine farmers to meet rising costs and higher land charges and can provide their families with a better standard of living.

This article has been contributed by **John Jones, B.Sc., N.D.A.,** who is N.A.A.S. regional grassland husbandry adviser in the Yorks/Lancs Region.

Calf Rearing Feature

This feature on a topical subject contains articles by

★ **A. H. Adamson, B.Sc. (Hons.),** a Nutrition Chemist in the National Agricultural Advisory Service, who is stationed at Leeds. As a member of the N.A.A.S. Beef Group he has been particularly concerned with various aspects of beef calf nutrition.

★ **W. A. Thompson, A.R.I.C.S.,** a Farm Buildings Advisory Officer in the Agricultural Land Service. Before joining the Ministry in 1959, he was in private practice for nine years in Kent, Hampshire and Dorset. Mr. Thompson has a special interest in calf housing and carried out a survey of calf housing in the West Midland Region in 1965.

Photograph by courtesy of The National Trust

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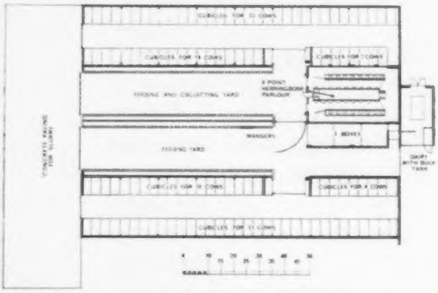

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Calf Nutrition

Some Qualitative Aspects

A. H. Adamson

It is difficult, if not impossible, to apportion accurately the 5–10 per cent of national calf mortality to various contributing factors, but it must be accepted that malnutrition plays a part, either directly or indirectly. Malnutrition refers not only to over or under feeding in quantity, but also covers sub-optimal quality and whilst the quantitative aspects which are well publicized can be measured directly on the farm, and hence are relatively easy to follow, quality is somewhat vague and requires more elucidation.

Colostrum

The virtues of feeding colostrum to the newly-born calf are well established: it is a source of immunity against disease in the dam's environments and also a super-quality milk. The immunity is associated with part of the protein fraction (globulin) but there can be a marked variation between cows in the colostrum globulin level. In addition, globulin concentration, and presumably the antibodies, can fall to less than a third of the original high value within twelve hours of parturition. The calf intestine remains permeable to these antibodies for a relatively short period *post partum* and in some cases this can be as little as six hours. However, recent work suggests that in general a high rate of absorption occurs for the first 12 hours of life. Whilst less than one pint of first-drawn colostrum is claimed to provide immunity against *E. coli* septicaemia, all the above factors should be considered during the critical early days of the calf's life. Leaving the calf to suckle on its own initiative is no guarantee that colostrum will be taken early. A limited survey showed that a sizeable proportion (30 per cent) of market calves received little or no colostrum as measured by calf serum examination, but it is feasible that this was partly due to mistiming rather than total absence of colostrum feeding. Calves should, therefore, be fed colostrum as soon as possible after birth.

The relative values of colostrum and milk as sources of nutrients are illustrated in the following table.

Transition of composition from colostrum to whole milk

		Colostrum ⟶					*Whole Milk*
		Birth	12 hr	24 hr	48 hr	8 days	14 days
Total solids	%	23·9	17·9	14·1	13·6	13·6	12·9
Fat	%	6·7	5·4	3·9	4·3	4·3	4·0
S.N.F.	%	16·7	12·2	9·8	9·5	9·1	8·8
Total protein	%	14·0	8·4	5·1	4·1	3·4	3·1
Lactose	%	2·7	3·9	4·4	4·7	4·9	5·0
Mineral ash	%	1·11	0·95	0·87	0·81	0·78	0·74

These figures are based on American work using Holsteins and show the change in composition of udder secretions after calving. In addition, the vitamin A level of whole milk is only about 20 per cent of that in the original colostrum. The sharp decrease in total protein in the first 12 hours after parturition is of particular interest and demonstrates the value of first-drawn colostrum as the first feed. Colostrum is also considered to have beneficial effects on the consistency of the dung, although the specific advantages are not clear.

Milk substitutes

Whole milk is the ideal food for the young calf. The apparent digestibilities of the dry matter, fat, protein and lactose fractions range from 93·5 to 100 per cent, but milk at 2*s*. 6*d*. per gallon or 2*s*. per lb of dry matter does not appear to be as attractive financially for calf food as dried skimmed milk at less than 1*s*. per lb. The question arises as to the comparative quality of these two products. Careless processing of skimmed milk destroys some of the protein and the shortage of energy, due to the removal of fat, reduces the efficiency of utilization of the digested protein to nearly half that of whole milk. For example, spray drying of skimmed milk at 77°C for 15 seconds causes 15 per cent of the protein to be denatured, but holding at this temperature for 30 minutes causes 50 per cent denaturation and drying at still higher temperatures has a similar but more severe effect. This not only reduces the digestibility (and hence growth rate) but also resistance to intestinal infection, particularly *E. coli*.

Unfortunately, quality of the skimmed milk base in milk substitutes can only be measured on the farm by the calf's performance, and with so many other factors affecting growth the farmer is very much in the hands of the manufacturers. Even a high-quality dried skimmed milk requires the replacement of lost butterfat by alternative sources of energy for optimum protein utilization. The dry matter of whole milk contains 25–30 per cent of butterfat and in the production of milk substitutes efforts have been made to replace the fat removed with either vegetable or other animal fats. Carbohydrates other than milk sugar (composed of glucose and galactose) are difficult to digest at an early age in the non-ruminating calf and hence the need for fats.

A number of fats and oils are used for milk substitutes, either separately or in various combinations, e.g., beef and mutton tallow, lard, palm oil, corn oil and coconut oil. Although tallow is the least digestible of these at a maximum of about 85 per cent digestibility, it is still sufficiently well digested to justify its inclusion. The fat must be incorporated in such a manner as to produce a fat globule small enough to allow maximum digestibility, and this is achieved either by homogenization or emulsification, or both. This is particularly important during the first three weeks of life.

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Once again the farmer is unable to evaluate the adequacy of incorporation but must rely on calf performance, bearing in mind the other variables. Low fat digestibility will lead to reduced growth rate and perhaps loss of hair from the parts of the body with which the faeces come into contact.

Present experimental evidence is that a fat level in milk substitutes as high as that contained in whole milk is unwarranted, and the optimum level is about 18–20 per cent. However, there is as yet insufficient published evidence to show a significant *commercial* advantage of a high fat diet over one of low fat for early-weaned calves.

It is traditionally accepted that milk substitute should be fed at blood heat, but it was shown in 1950 that it could be fed cold, and more recent work at the Grassland Research Institute, Hurley, with calves fed out of doors, has demonstrated the practical possibilities of low temperature liquid feeding, without ill effects. After further investigation this may well become common practice in the future and especially for early-weaned calves which drink relatively small quantities of milk.

The quantities of a high-quality milk substitute fed in suitable hygienic and environmental conditions will depend on the type of production required, with the veal calf at one extreme and the traditional dairy heifer calf at the other. Where the beef calf lies within these limits is by no means clear as yet—especially for different systems of beef production.

Concentrates

In most circumstances the term 'concentrate' covers a dry ration fed to appetite from a few days of age. The optimum crude protein level is about 16 per cent, and the type of protein is now known to be important for young calves. Fish meal is superior to soya bean meal, which in turn is better than groundnut. Since there is no evidence to show that a complex mixture is more acceptable than a simple one, a ration could be formulated based on fish meal, flaked maize, barley, minerals and vitamins. Groundnut should not be used for young calves.

The rate of engineering progress is such that it is feasible that the mechanical liquid feeding of pigs may well be extended to include calves, using a dry concentrate mixture suspended in water. Whereas dry concentrates undergo ruminal fermentation, liquids by-pass the rumen and are digested in a similar manner to the simple-stomached pig. Recent work has shown that this increases the efficiency of protein utilization which in turn is related to growth rate. Despite this, starch, which is the principle energy constituent of cereals, is not digested efficiently by the non-ruminating calf. However, by supplementation with fat, even better use can be made of the dietary protein. Whilst this system cannot yet be recommended commercially, the potential advantages are encouraging, although in practice increased automation of animal feeding almost invariably raises unsuspected problems.

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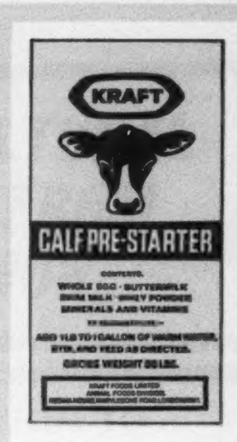

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Broadly speaking there are three main aspects of housing design which have a bearing on calf health. Firstly, the environment or living conditions which a house provides will play a large part in determining the animals' susceptibility to disease, in particular to respiratory diseases. Secondly, the siting of the calf house will to some extent control the amount of disease brought in from external sources; and the internal layout will determine the amount of physical contact and disease transfer which occurs between calves. Thirdly, the materials used in construction, and the method of construction, will largely determine the effectiveness of cleaning-out and will therefore have a bearing on the level of residual disease build-up.

Environment

The climate within a building consists of two main elements, namely, temperature and relative humidity. The controlling factors which determine the levels of temperature and relative humidity are heat input, insulation and ventilation. Probably the most firmly held belief amongst calf rearers is that a widely fluctuating temperature in a building must be avoided at all costs. This is not disputed, but the means of achieving an even temperature in many cases is open to criticism.

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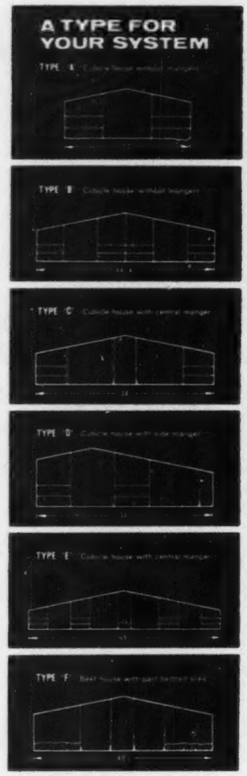

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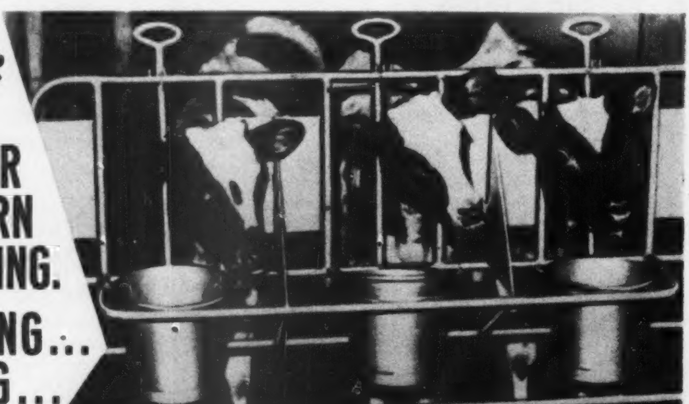

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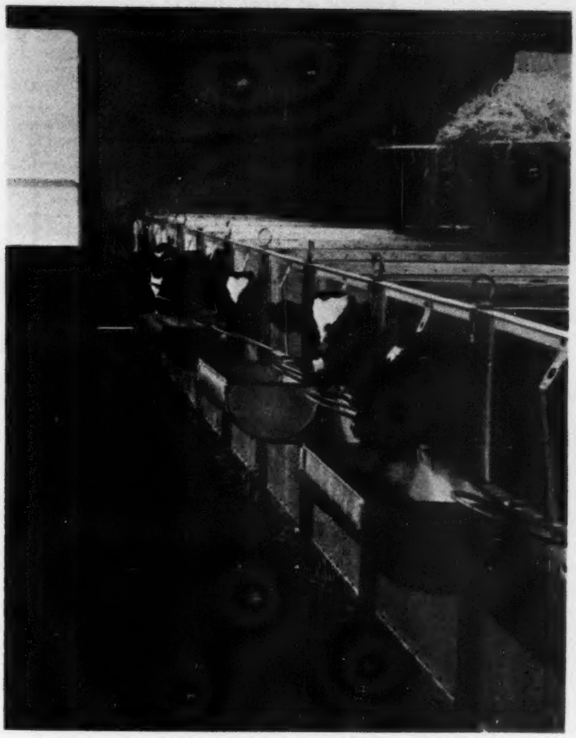
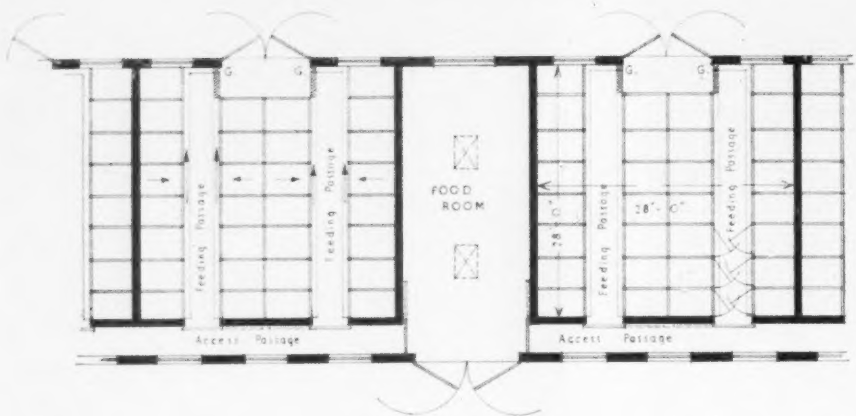


Individual pens with easily cleaned surfaces. The pens are dismantled simply by removing the hinge pins at the corners

The vast majority of calves are reared in converted buildings of traditional construction and the standard of insulation is not high. Old cowhouses are probably the most commonly used. The heat loss from such buildings will be fairly high, and therefore the internal temperature will fluctuate quite widely as the external temperature varies. The maximum temperature will normally occur in mid-afternoon and the minimum in the early hours of the morning. At certain times of the year, particularly in late autumn and early spring, the diurnal temperature range can be as much as 30°F (17°C) outside, and it is not unusual for the internal temperature to fluctuate as much as 20°F (11°C) in such conditions. Heat is lost in two ways (*a*) through the structure and (*b*) through ventilation. The most obvious, and supposedly cheapest, way to conserve heat is therefore to reduce the ventilation. But to achieve this in poorly insulated buildings, ventilation usually has to be stopped altogether. This certainly reduces the temperature fluctuation, but at the same time it raises the relative humidity. The results, which are common knowledge to anyone who has had any experience of stock buildings, are a cold damp raw atmosphere, streaming walls, dripping ceilings and wet bedding—altogether perfect conditions for respiratory disease.

How do you prevent this state of affairs, bearing in mind that under no circumstances should all the ventilators be closed? There is a choice between (*a*) providing artificial heat to make up for heat lost or (*b*) preventing heat loss by providing insulation either to the complete building structure or to the calf pens only. The choice between (*a*) and (*b*) will depend mainly

Layout of large unit in compartments of 30 calves served by a common access passage



on the nature of the building. In the case of very high lofty buildings the cost of providing insulation may be prohibitive or the building may be required for other purposes which need the height. If straw is plentiful then kennel-type pens could provide the answer. If straw is not readily available infra-red lamps over the calves will be the choice. The building may be so constructed that the fixing of insulation is a comparatively simple matter. In this case it may work out cheaper to insulate the whole building or to provide both improved insulation to areas of greatest heat loss, e.g., the roof, and to supplement by artificial heating.

A word of warning: stocking density in terms of overall cubic capacity of the building is an important factor in determining whether natural ventilation will be sufficient or whether mechanical ventilation will be necessary. Insulated ceilings may increase stock density in terms of overall cubic capacity per calf and make mechanical ventilation essential.

Siting and layout

Ideally the calf house should have a natural isolation from all other livestock because inevitably with bought-in calves there are risks of contagious diseases, e.g., salmonellosis. Older animals may be carriers of disease without exhibiting any outward signs, and it is therefore wise to prevent contact between young calves and older animals. Separate buildings are a great help in this respect. Separation of young calves by individual penning, at least up to weaning, prevents undesirable habits such as navel sucking. Pen divisions should be solid to a height of at least 2 ft 6 in. from the floor to prevent calves from coming into contact with the excreta of one another.

The risk involved in spreading disease to a large number of calves in one building is obvious, and the bigger the house the greater the risk. Don't keep all your eggs in one basket: large calf houses should be sub-divided into smaller compartments containing 20–30 calves, and these compartments should not be inter-communicating. This system enables separate compartments to be completely isolated in the event of an outbreak of disease. It also makes it possible to rest one section independently whilst maintaining the throughput of calves in the remainder of the house.

Attention to detail in the matter of materials used and the method of application and construction will pay off in greater efficiency of cleaning out and sterilization. Removable pen partitions, with smooth surfaces and simple fittings, facilitate rapid and effective cleansing. The surfaces of all masonry walls should be rendered to a height of 4 ft above floor level and finished with a steel float to produce a smooth, dense, non-absorbent surface. Sharp angles and corners should be avoided: rounded or coved skirtings between walls and floors are essential. Old rendered walls which are absorbent but otherwise sound can be painted with one of the new resin-based paints. The walls must, however, be cleaned down thoroughly before painting and the manufacturers' instructions on application closely followed. On no account use lead-based paint. Finally, make sure that the floor has a damp-proof membrane to prevent rising dampness and ensure that the falls are adequate to facilitate rapid drainage. The recommended standard is 1 in. in 5 ft.

Remember, every calf that dies through poor housing will mean a loss in the region of £20 and it does not cost many times £20 to make even the worst building reasonably habitable.

Save Those Calves

When buying calves remember that every calf is in danger as soon as it is born and that losses in bought calves are more than double those of calves reared on the farm of origin. Buy, whenever possible, direct from the breeder. Don't take delivery at under one week old and insist that the calves you buy have had colostrum (beastings) from their mother. To achieve the highest protection against disease a calf should be fed on colostrum as soon as possible after birth. Don't buy weakly calves, above all, those with scours or discharge from the nose.

Calves should not travel within one hour of their last meal, and should be moved carefully without delay direct to their destination. Vehicles should be clean, warm and airy, though not draughty; this is particularly vital from November onwards.

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EARLY TOMATOES

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A report on work at Efford Experimental Horticulture Station

ABOUT 80 per cent of the activities of the glasshouse department at Efford is devoted to experimental work with tomatoes. This reflects the importance of the crop in the south-east region which the Station serves. Although this article relates solely to work on early tomatoes done at Efford, similar experiments have gone on concurrently at the other Experimental Horticulture Stations where glass is important. At all of them, close acquaintance with growers' problems means that the type of work being done and the findings are, in the main, immediately applicable in the field. Stations with a lively experimental programme are able to give a lead to the industry. At Efford it is refreshing to meet visiting parties and to find how interested they are becoming; not only do they criticize—and almost all the criticism is constructive—but they relate their experiences on taking up suggestions made the previous year. And they usually take away more ideas to incorporate in their growing methods in future seasons.

The early work which was begun at Efford in the mid-fifties, primarily in co-operation with the National Institute of Agricultural Engineering, was of a basic nature. It concerned glasshouse orientation and automatic heating and ventilating systems. This work, which was often tedious and time-absorbing, formed a firm foundation for the cultural experiments which followed. At the same time, soil treatments, watering and nutrition, variety testing and plant spacing were being studied. Later work has examined precise day and night temperature regimes, propagation techniques, effects

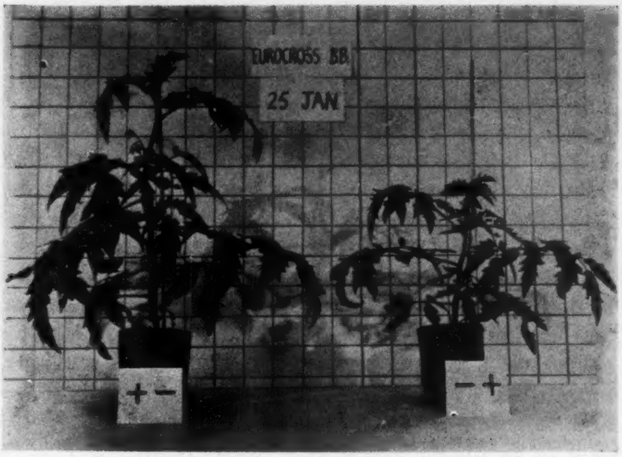
of root restriction, reducing by cultural means the losses caused by tomato mosaic virus (TMV), the continued testing of new and improved F.1 hybrids of different growth habit bred at the Glasshouse Crops Research Institute and, most recently, enrichment of the glasshouse atmosphere with carbon dioxide (CO_2) to accelerate growth and fruit production.

Heating systems

Detailed records begun in 1957 showed that, because of their reduced thermal inertia, systems of small-bore heating pipes, 1¼ inches in diameter, carrying low-pressure steam or high-speed hot water, maintained a particular temperature regime more accurately than the 4 inch diameter hot water pipes then in general use. As a result, small-bore systems are in use in Efford's tomato houses, and they are now standard equipment in the industry. Development of the N.I.A.E.'s electrically-operated automatic ventilating gear has meant not only a large saving in labour but a considerable improvement in the accuracy of air temperature control. A hydraulically-operated system devised elsewhere is also being used successfully. Thermostats, which actuate both heating and ventilating systems, are held in insulated and aspirated boxes set among the tomatoes in the centre of each glasshouse. This ensures that control equipment is exposed to the true air temperature, records having shown that exposed thermostats can err to the extent of about 20 per cent.

It was soon realized that accurate temperature control was of restricted value without knowing what optimum growing temperatures really were. A series of experiments established that not only were growers generally using insufficient heat, but that day temperature had a much greater effect in accelerating growth and cropping and in improving fruit setting and quality than did the temperature at night. A wide variety of day and night temperature combinations were tested to clarify the situation. In conjunction with research and other Experimental Horticulture Stations, a compromise

Plants of the variety Eurocross BB standing in the growing house. Those on the right were enriched with CO_2 during propagation and were 10 days ahead of those on the left



This picture shows more clearly the difference between enriched (left) and unenriched plants. Both were sown on 19th November and photographed on 25th January

temperature regime for early tomatoes was arrived at in 1964 (see Table 1). It now forms the basis of N.A.A.S. advice, but is modified where glasshouses have poor light transmission or are situated away from the southern coastal belt; it is followed as nearly as possible where inadequate heating systems have yet to be replaced.

TABLE 1

Standard N.A.A.S. temperature recommendations to be used as a guide following a mid-November sowing

Stage of growth	Night temperature °F	Positive day temperature °F	Ventilating day temperature °F
Pricking out—visible bud	58	64	74
Visible bud—first flower	60	64	74
First flower—month after start of picking*	62	68	75
To end of cropping	62	64	70

*7 weeks with CO_2 enrichment

Propagation techniques

The propagation period is vitally important with early tomatoes and can have a profound influence upon early yield. Initial work with the N.I.A.E. showed that during the very poor light period between October and December, when plants are being raised, 20 per cent more of the sun's radiation entered the John Innes uneven-span propagating house orientated east-west than was transmitted into a conventional house orientated north-south. Taking advantage of better light, propagation techniques were examined in great detail. It was found that growth rate was fastest where plants were grown in $4\frac{1}{4}$ inch non-porous (whalehide or plastic) containers filled with J.I.P. compost set on an open mesh bench, and where dissolved nutrients were applied with all waterings given after the fifth true leaf stage, never allowing leaves to overlap and shade neighbouring plants. It was also found that planting was best done when half the plants had one flower open

on the first truss, and that the most profitable planting density was about 13,500 plants per acre of glass. Provided standard temperatures were used, no overall advantage was found in restricting roots after planting out.

A standard fertilizer concentrate consisting of 27 lb ammonium nitrate, 73·6 lb potassium nitrate and 21·3 lb magnesium sulphate, dissolved in 40 gallons of warm water, has been found to be suitable for liquid feeding right through the season. It provides a nitrogen/potash ratio of 1 : 2, and is used at a dilution rate of 1 : 300 with irrigation during propagation, and generally at 1 : 200 after planting, the rate being altered occasionally according to the type of growth being made. A relationship between incoming solar radiation and the amount of water used by a tomato crop, first exploited by the N.I.A.E., has been developed on the Station and is always used to calculate water need after planting. Watering is done three times weekly through low-level sprinkler lines and this, together with continuous feeding, is achieved at the turn of a tap; no day-to-day decisions have to be made. The weekly 'water figure', as it is called, is also supplied to growers through N.A.A.S. county advisers.

Defoliating

Defoliating experiments showed that there was no significant effect on total yield, fruit size, shape or gross market value when leaves were removed to two trusses above that with ripening fruit, as compared with no leaves being trimmed off at all. As a result, defoliating is done at Efford only when it is necessary to improve air circulation around the plants or to remove dying leaves. The effect of TMV in reducing yield and quality has been considerably reduced when sowing has been done three weeks earlier than usual and the seedlings deliberately inoculated at the cotyledon stage. Losses have further been reduced when plants were grown 'hard' at standard temperatures. A great step forward will be made if varieties with inherited resistance to the disease, presently being tested at Efford, became available.

TABLE 2

Total yields and values of marketable fruit up to 32 weeks of picking (to 4th November) from tomatoes grown at standard temperatures with and without CO_2 enrichment from pricking out to mid-May

Variety	*Treatment*			
	Unenriched		*Enriched*	
	Yield (tons/acre)	Value (£/acre)	Yield (tons/acre)	Value (£/acre)
Eurocross BB	82·1	13,538	115·4	20,929
J 168	90·8	15,700	102·2	20,144
J 154 R	90·4	14,471	114·2	20,348
Ware Cross	93·0	15,081	104·7	19,652
Mean	89·1	14,698	109·1	20,268

Last season the largest yield increases resulting from any experimental treatment so far attempted were obtained with enrichment of the glasshouse atmosphere with CO_2 to three times the normal level from pricking out until mid-May. Table 2 shows how valuable these increases were, and enrichment has already become standard practice with early tomatoes at the Station. Work is now being done to determine what is the most profitable

period of enrichment. A demonstration house has been set aside to show growers the combined effect of all growing techniques used at Efford, and to illustrate the 'precision growing' methods we use. In addition to saving labour, one of the great advantages of automated procedures used in conjunction with experimental evidence is the fact that a 'blueprint for growing' can be prepared in advance of sowing and followed, virtually without modification, right through the season.

It is only possible in a short article of this nature to give an abbreviated description of the ten years of work on tomatoes at Efford, and readers who would like to know more are advised to consult the annual reports issued by the Station.

Derek Smith, B.Sc., M.S., Ph.D., N.D.H., M.I. Biol., A. Inst. P.A., joined the N.A.A.S. in 1954. Five years later he left for New York to spend three years at Cornell University studying precision growing of glasshouse flower crops. On his return in 1963 he took charge of the Glasshouse Department at the Ministry's Efford Experimental Horticulture Station.

The Ministry's Publications

Since the list published in the May, 1966, issue of *Agriculture* (p. 226) the following publications have been issued.

MAJOR PUBLICATIONS

Experimental Husbandry No. 13. May 1966 (New) 7*s*. 6*d*. (by post 8*s*. 1*d*.)

ADVISORY LEAFLETS

(*Price 4d. each—by post 7d.*)

No. 271. Potato and Tomato Blight (Revised)
No. 277. Reversion Disease and Gall Mite in Black Currant (Revised)
No. 358. Onions (Revised)
No. 431. Feeding Chicks and Growing Stock (Revised)

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No. 31. The Broiler House (Revised) 2*s*. 6*d*. (by post 2*s*. 11*d*.)

FREE ISSUES

STL No. 19. Choosing Selective Weed-killers (Cereals) (Revised)
STL No. 52. Suggestions for Weed Control in Vegetables (New)
Statutory Grading—Horticultural Produce (New)
Farm Incomes, Cost and Management (Revised)

The priced publications listed above are obtainable from Government Bookshops (addresses on p. 300), or through any bookseller. Unpriced items are obtainable only from the Ministry (Publications), Tolcarne Drive, Pinner, Middlesex.

Network Analysis

a technique of work planning

in agriculture and horticulture

A. K. Giles and L. G. Bennett

Because of the relatively small size of the majority of farming businesses, agriculture and horticulture tend to lag behind large-scale manufacturing industry in the adoption of specialized techniques of management. Nevertheless, the position of farming *vis-à-vis* other forms of industry is being modified as professional services of all kinds—technical and business consultants, accountants, commercial and Ministry of Agriculture advisers, and so on—become increasingly used and as the value of such professional services in easing the management burden of the farmer receives increasing recognition.

A novel management technique

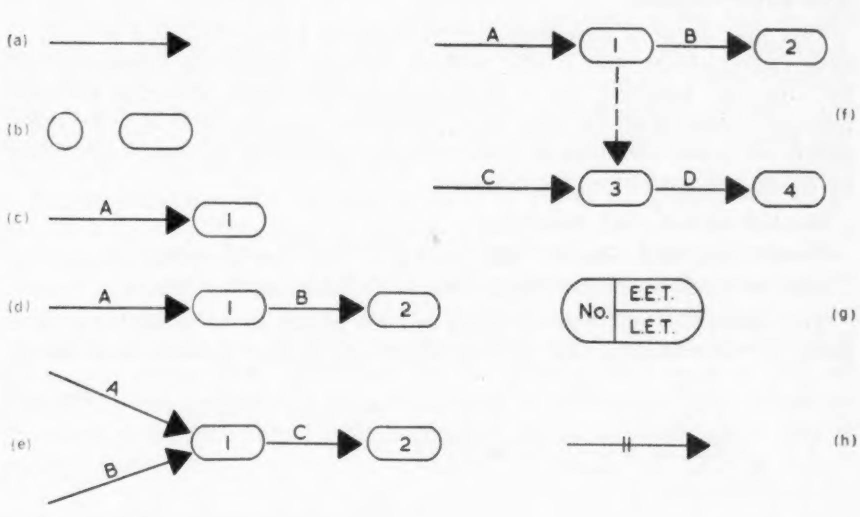
This article defines what for agriculture is a rather novel management technique—network analysis. It also describes the application of the system to a real-life situation. Network analysis is essentially a technique for planning work. Like work study, it is concerned with the separate components of a job, with analysis, with examination and with improvement. Unlike work study, however, it is not primarily concerned with the time and methods employed in each component of a task, but rather with overall planning, with clarifying complex situations and with the identification of critical jobs. The so-called network indicates, among other things, where work study can be most effectively applied.

Networks are a product of the late fifties and early sixties during which time they gained rapid acceptance, especially in the construction and armament industries. The earliest forms of network (Programme Evaluation and Review Technique and Critical Path Method) have provided the basis for numerous more recent developments. These range in the degree of complexity from those involving no more than a simple diagrammatic guide to planning projects up to specialized computer routines. The technique has thus great flexibility in application. Bearing in mind the 'Jack-of-all-trades' role of the manager in British agriculture, it seems likely that it is the simple type of network which, for the time being at least, is likely to be of most use in farm management and with which, therefore, this article is concerned.

Principles of network analysis

Like work study, network analysis has its own logic and symbols. These are used to plan a sequence of events in which each stage in a given job or project is identified, timed and related to preceding and succeeding events. The whole proceeds in the quickest possible time to a successful conclusion. Networks are composed of a series of *activities* linking a series of *events*. Each activity is represented by an arrow—see fig. 1(*a*). Each event is a point of time when an activity has been completed and is represented by a circle or a node—see fig. 1(*b*). The node is sub-divided as shown later to show timings which are relevant to that event. These two symbols, the arrow and the circle or node, can now be combined to show the sequential relationship between any particular chain of events. Thus, in fig. 1(*c*) event 1 has been reached only after activity *A* has been completed. In fig. 1(*d*) activity *B* cannot begin until event 1 has occurred and event 2 marks the completion of activity *B*. In fig. 1(*e*) activity *C* cannot begin until event 1 has occurred. Event 1 does not occur until activities *A* and *B* have both been completed. *A* and *B* are therefore 'concurrent' activities. Where one event cannot occur before another event has been completed, but no activity links them, a dummy arrow, as in fig. 1(*f*), is used to denote this relationship. In fig. 1(*f*) activity *B* depends only on activity *A* and event 1. But activity *D* depends on the completion of activities *A* and *C* and the occurrence of events 1 and 3.

Figure 1.

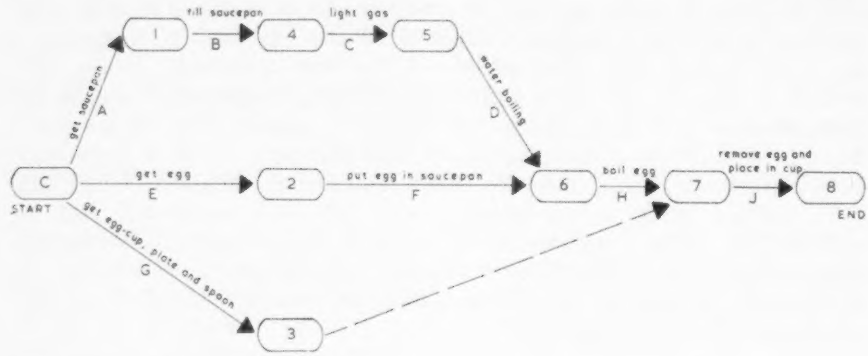


A simple example

Equipped with these symbols and the conventions attached to them, it is now possible to proceed to the preparation of a network. Before dealing with a more complex situation the very simple process of boiling an egg is used as an example. This is one with which most people are familiar and not without agricultural associations! The first step in any network is to make a list of all the various parts of the job, such as: get egg; get saucepan and fill with water; put saucepan on gas, and light; get egg cup,

etc. For convenience, jobs are arranged in 'technological order', i.e., no job appears on the list until all its predecessors have been listed. All activities with no predecessors are connected to a 'starting' or 'lead' node and all those with no successors are connected to an 'end'. The starting node can be numbered 'zero' or 'one' and numbering proceeds generally from left to right and from top to bottom with, for any activity, the end event number always being greater than its beginning event. For labelling purposes letters can be used to describe activities and our initial 'egg-boiling' network might look as it is laid out in fig. 2.

Figure 2.



The time element

This first network describes the sequence of events involved as well as their interrelations. But it tells nothing of their individual timing, nor of the total time involved, nor of those critical tasks which determine the total time and which must be done more quickly if the total time is to be minimized. In order to establish these facts the following measurements must be made, and entered on the diagram:

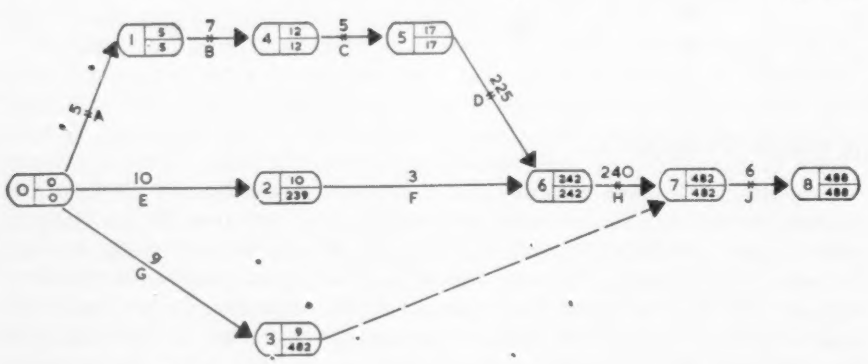
(*a*) The time of each activity;

(*b*) the Earliest Event (starting) Time (E.E.T.) for each event;

(*c*) the Latest Event (starting) Time (L.E.T.) for each event.

The network is redrawn in fig. 3 in such a way as to show these three kinds of information. The activity times are written against each arrow.

Figure 3.



Each node shows the event number together with the E.E.T. and L.E.T. as shown in fig. 1(*g*). The E.E.T. is obtained by beginning at the start event (zero time) and adding, successively, each activity time to the accumulated time of all preceding activities. Thus, starting at zero, activity *A* in the example lasts 5 seconds and the earliest possible starting time for event 1 is therefore 5 seconds. Similarly the E.E.T. for event 2 will be 10, and for event 4 it will be 12 (i.e., the combined duration time of activities *A* and *B*). Where two or more arrows enter one event, the longest 'path' time to reach this event becomes its E.E.T. Thus event 6 has an E.E.T. of 242.

To establish latest starting times (L.E.T.) that will not extend overall duration the reverse procedure is adopted. From the E.E.T. of the 'end' event (which is also its L.E.T.) the duration of each activity is subtracted and where more than one activity originates at a common event, the lowest number (after subtraction) becomes the L.E.T. of that event. Thus, with an E.E.T. and L.E.T. for the end event (event 8) of 488 seconds, the L.E.T. for event 7 becomes 482, for event 6, 242 seconds, etc.

Determining the critical jobs

The difference between the Latest Event Times and the Earliest Event Times for any one event is known as its *slack*. This slack is important as it represents the maximum amount of time a job may be delayed beyond its earliest start without delaying the final completion of the job. Thus event 2 has a slack of 229 seconds (239 minus 10). After that time the egg must be obtained (10 seconds) and put in water (3 seconds) if the total job time is not to be extended, the water having been brought to the boil in 242 seconds. A similar concept applied to activities is called *float*. It measures the time that may elapse before an activity has to begin if the finishing time is not to be set back. It is calculated by subtracting the activity time from the difference between the E.E.T. of the event preceding the activity and the L.E.T. of the event succeeding it.

The all-important critical path in fig. 3 is shown by activity arrows as shown in fig. 1(*h*). They link the critical jobs, namely, those which determine the total duration of any task or project. In a simple network it may be found by inspection from those events and activities without slack or float. It has been estimated that in most large projects only about 10 per cent of jobs are critical. These are the jobs to which work study should be applied if the overall project time (and cost) is to be reduced. As a result of this, of course, the critical path may be moved. So far as boiling an egg is concerned the moral from the critical path is clearly to fill a saucepan and to put it on a high gas first.

An example in horticulture

Because network analysis has scarcely been used in the agricultural and horticultural industries examples are hard to find. It is fortunate, therefore, that in the recent construction of a 1/3 acre block of alloy glasshouses at the Horticultural Station of the University of Reading the time which each operation would take was known and the job therefore lent itself to network analysis. It would be as well to explain that most of the work in building this block of glass was done with the labour on the Station, that enough men were available to carry out the operations or 'activities' in the times given, that before any decision to build was taken or any work commenced

the whole operation was budgeted not only as to capital costs but also as to annual income and expenditure, and that the revenue budget was based on cropping with carnations to be planted on 16th June in the following year. There was, however, some flexibility in the plan because part of the building work, such as fitting the heating pipes and even glazing the sides, could be done if necessary after the house was planted. Nevertheless, building operations were planned on a tight programme and delay in planting after 16th June would have been out of the question. This was because the supply of plants was contracted for with a specified delivery date some six months ahead and with a substantial discount for early ordering. The activities concerned in the whole process are listed below, together with the number of days each activity occupied. It will be obvious that an activity like 'order glass 56 days' means that from ordering to delivery on site 56 days elapsed, although no work by the building crew was involved. On the other hand 'glaze roof 21 days' means that the staff were engaged for this time in fitting the sheets of glass to the framework.

ACTIVITIES	DAYS
Order plants	182
Order glass	56
Order cement and aggregate	1
Order blocks	7
Order bulldozer for site levelling	42
Level site	2
Bore holes for supports	1
Fill holes to level	2
Build superstructure Fit glazing bars	42
Makers square-up the building	1
Glaze roof	21
*Fit glazing bars on sides and ends	30
*Build walls	18
*Glaze sides and ends	60
Fit knee braces on roof	14
Prepare beds	7
Plant	7
**Order pipes	112
**Order calorifier	112
**Hire contractor to fit calorifier	120
**Lay pipes and fit calorifier	21

START Mid-December

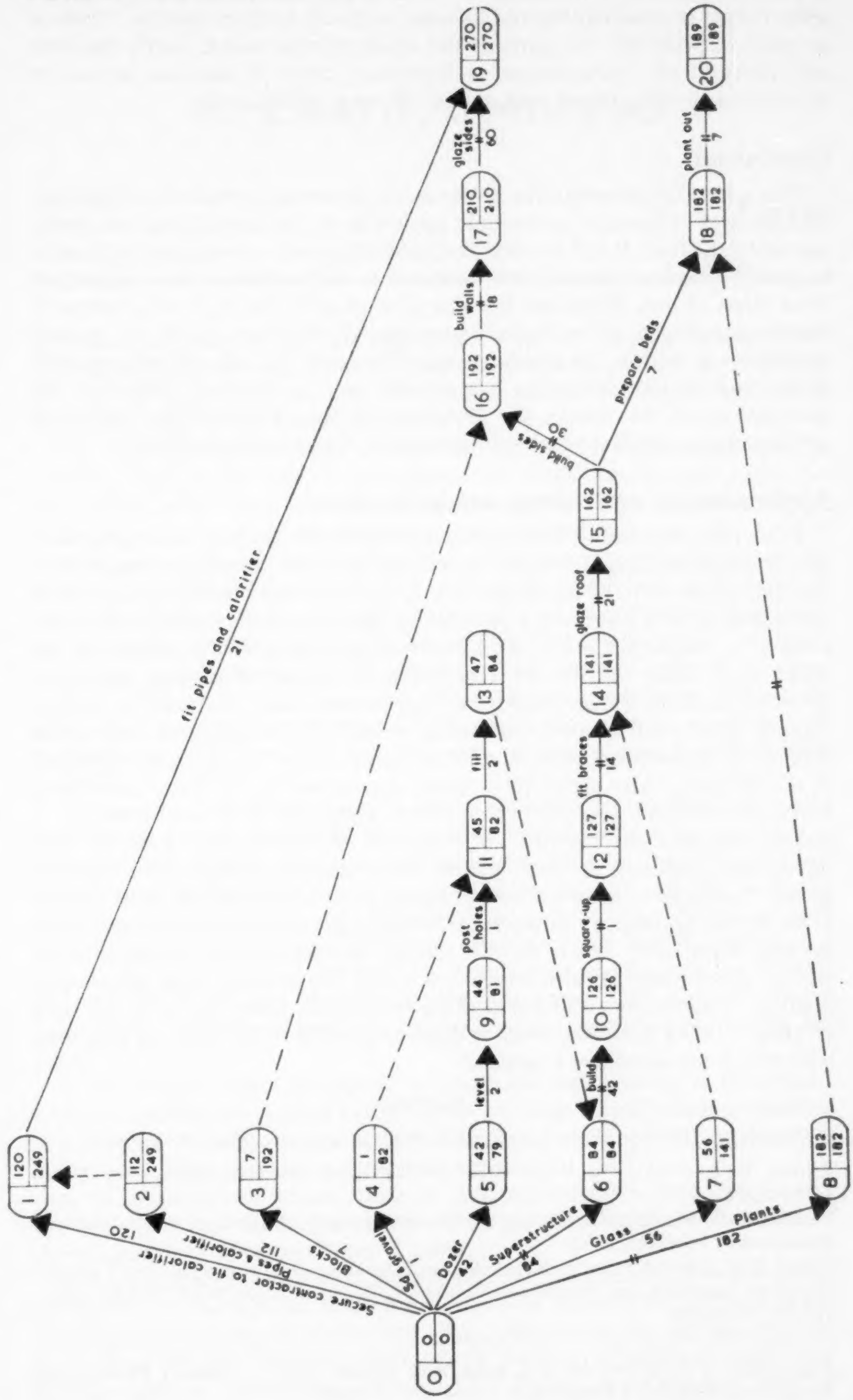
FINISH Mid-June

Starred activities could have been carried out after mid-June but had to be done * before September; ** before November.

The critical paths

From the network shown in fig. 4 (opposite) it will be seen that there are two critical paths each one relating to two different end events. One is the completion of the planting-out process and the other (which extends beyond the planting time) is the final completion of the structure. For the first, the critical path is along the line of events 20, 18, 8, 0, and for the second, along events 19, 17, 16, 15, 14, 12, 10, 6, 0. It will also be seen that there is an activity float of 6 days between events 15 and 18 which means that the activity 'preparation of beds' could have been delayed for that time without running into the difficulty of having plants delivered and nowhere to plant them. This is a relatively small amount of float and no more than

Figure 4.


Secure contractor to fit calorifier
120
Pipes & calorifier
112
Blocks
7
Dozer
42
Superstructure
84
Glass
56
Plants
182
level
2
post holes
1
fill
2
build
42
square-up
1
fit braces
14
glaze roof
21
build sides
30
prepare beds
7
build walls
18
glaze sides
60
plant out
7
fit pipes and calorifier
21

is perhaps prudent in this kind of work. On the other hand the slack for some events is considerable and in some cases up to three months. There is no need to point out the parts of the whole process which justify the time and effort of the management in shortening them if they are set out in network form; the critical path stands out with great clarity.

Conclusion

This article has attempted to illustrate the elementary principles of network analysis and to provide an example applicable to the agricultural and horticultural industries. It will be clear that the technique is one designed primarily to clarify complex planning situations and to differentiate what is important from what is not. Whatever the size of a project, the logic of a network remains simple. In its simplest diagrammatic form it can clearly aid general management, both in the planning stage of a particular job and subsequently in its control. Its application has already been widespread, including the construction of motorways, the planning and launching into the market of new products, and large-scale installation or maintenance projects.

Application to agriculture and horticulture

This article has shown that there are possibilities of using it in agriculture and horticulture also. It would be wrong, however, to give the impression that the preparation of a network is a simple process. Like many aspects of management, it is primarily a job for the specialist. Skill in this, as in other fields of management, can come only from practice and it is difficult to see many work-a-day farmers or farm managers rapidly becoming experts in network analysis. Nevertheless as agriculture and horticulture slowly become more professionally minded in respect of management, and as the services of specialized advisers and consultants are increasingly employed in the industry, there seems little doubt that networks will have their place. Fields for network analysis which come readily to mind are: planning a minimum-total-time sequence of events in bottleneck-type jobs such as harvesting; planning the introduction of a new enterprise or the erection of new buildings to meet a seasonal deadline; and selecting the most fruitful areas for the application of work study where general labour problems exist. As with work study, this is another tool for the manager and in good hands will do good work. As also with work study, the greatest value of network analysis to agriculture and horticulture may finally prove to be the attitude of mind to work planning which it helps to develop rather than the precision with which the technique is applied.

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41. Chard, Somerset

J. S. Farrer

RUNNING southwards from the edge of the Vale of Taunton Deane, Chard district occupies the south-western corner of Somerset and is bordered by Devon and Dorset. To the east it extends to beyond Crewkerne and north-east to the edge of the Somerset 'moors'.

Soil type and rainfall largely decide the types of farming system. On the western edges of the district the Blackdown Hills rise to over 1,000 feet and consist of a series of small plateaux intersected by numerous valleys. These plateaux have moderately fertile soils derived from the cap of Clay-With-Flints, with the underlying Upper Greensand out-cropping at the valley sides. The annual rainfall of over 40 in., combined with drainage problems, dictates an all-grassland policy and small dairy farms predominate, the plough being used only for reseeding or kale. The cowshed reigns supreme, but silage is much used for winter feeding. There are also a few small sheep flocks. Although stocking rates are still quite low, progressive farmers, by improving grassland management and where housing is available, are building up stock numbers and the area in general has a considerable potential.

To the east of the Blackdowns is an area of heavy intractable Lower Lias clay. Much of this ground is also in grass, mainly long leys, but there is an expanding acreage of wheat with excellent yields on the better-drained land. Many of the small farms are devoted entirely to dairying, with the minimum of followers. As in the rest of the district, steer calves are sold at a few days old through Taunton, Ilminster and Yeovil markets for 'export' to other parts of the country. Sheep, pigs and poultry are of little consequence. Although the winters are not severe, the risk of serious poaching necessitates stock being off the land for up to five months of the year.

Much of this Lower Lias ground is 'Teart' and may give rise to an induced copper deficiency in grazing cattle due to the high molybdenum content of the soil and herbage interfering with the uptake of copper. The problem is recognized and remedial action can be taken.

A small acreage of teazles, once an important crop in Somerset, is still grown on the clay. The spiny heads of the plant are collected and used in the manufacture of certain types of cloth.

The small market town of Ilminster, with its fine church, is in the centre of the district, astride the A303 trunk road. On its western outskirts is the privately-owned Somerset Cattle Breeding Centre which provides an excellent example of intensive stocking of grassland. Its rows of tethered bulls are a familiar sight to holiday-makers bound for Devon and Cornwall. East of

Ilminster are the fine sandy loams of the Middle and Upper Lias. Though poorly structured and liable to flow or cap in very wet weather, these soils are fertile and easy working with good moisture-holding properties. With a rainfall of under 30 in., this is the main arable area of the district as well as having the largest and most intensive dairy units. Farms tend to be bigger and in addition to large blocks of cereals approximately 700 acres of main-crop and 150 acres of early potatoes are grown. The sugar beet acreage has dwindled due to transport difficulties, Kidderminster being the nearest factory. Although the warm, humid weather is ideal for grass production, it also means that potato blight arrives early and the incidence of mildew and latterly rhynchosporium (leaf blotch) in barley restricts the varieties which can be grown successfully. Despite this, the cereal acreage of the district has almost doubled in the past five years as stocking rates increase and acres become available for arable cropping. Horticulture is locally important with a small acreage of black currants, and savoys and autumn cauliflower following early potatoes.

A hurdled Dorset Horn or Down flock was once an integral part of the farming system on the Upper Lias but a high labour requirement and poor prices for early fat lamb have reduced the number and very few remain, several of them being specialist ram breeding flocks.

Many of the arable farms carry a dairy herd and there are some large specialist dairy units, with several herds of over 100 cows. Friesians predominate. Many new yard-and-parlour layouts have been erected in the past ten years but some are already too small and much work is involved in planning the conversion and extension of existing layouts.

Farmhouse cheese is made on one or two farms, with the farmer buying milk from several of his neighbours. A high proportion of the milk taken into the large factory at Chard Junction is turned into butter, and the by-products of cheese and butter-making are utilized by several large pig fattening units in the district.

Between the A30 and the Dorset border is a further area of Clay-With-Flints and Upper Greensand but since rainfall is lower than on the similar soil type further west, the holdings tend to be larger and some cereal cropping is evident on what used to be all-grass dairy farms.

No article on Somerset would be complete without mention of cider. The small orchards which adjoined many farmsteads in the east and south of the district are rapidly disappearing and the land put to more productive use. Only a very few farms now make their own cider although at least one small local factory still operates.

In addition to Ilminster, Chard and Crewkerne are the main centres of population. They serve a wide agricultural area and have a range of light industry which includes animal feeds, light engineering, shirts and the making of ropes and sail cloth (the sails of *H.M.S. Victory* were made at Crewkerne).

The route of the Fosse Way lies through the district and the sites of several Roman villas have been discovered. Before the Romans a more ancient race lived on the higher ground of the Blackdowns and their tumuli can still be seen. The mild climate and attractive villages have brought many retired people to this part of the county and numerous old thatched cottages have been beautifully renovated.

In short, it is a very pleasant part of England in which to live and work.

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Shelters for Hill Stock

THE propensity for sheep to find natural shelter is well known. With changes in management, however, such as the feeding of concentrates to hill flocks and the wintering of hoggs at home instead of on away ground, there is now a revived interest in providing artificial shelter. The returns from hill sheep are such that only limited capital expenditure can be justified for shelter, so that low-cost constructions are required.

Although sheep have been provided with various forms of shelter from time immemorial, a Scottish gentleman, one Captain Napier (a relation of the Napier of logarithmic fame) is credited with the stell as we know it today. The very early stells were small-diameter stone circles which gave shelter from all directions, and many of these can still be seen in hill districts. If the diameter was increased there was a tendency for snow to drift and accumulate within the circle. The traditional unroofed stell was constructed as a 30 ft-diameter complete circle, with the exception of a 3 ft-wide opening, with 6 ft-high dry-stone walls. Captain Napier recommended roofing over a portion of the circle, relying on airflow over the stell and the updraft through the open centre to keep the central area clear of snow.

Some few years ago the Rowett Research Institute used this principle to develop a stell for the wintering of ewe hoggs. Constructed of curved galvanized steel walls 4 ft 6 in. high, the stell had an overall diameter of 30 feet. A 6 ft-wide roof of flat galvanized steel sheeting rising to 1 ft 6 in. above wall height and with a 1 ft-high collar leaves an open central area of 18 ft diameter. Following this development by the Rowett Institute, proprietary stells to a similar pattern are now being marketed.

Napier recommended siting stells on exposed ground where the wind would sweep the snow clear and allow the sheep free access between the stell and the heather land. In selecting a site a level area must be sought for erection and providing storage for food. It is essential that a prefabricated stell is securely anchored to the ground. These considerations are likely to lead to a site nearer the lower ground rather than out on the hill tops.

A strategically-sited stell can also be valuable at lambing times. The site must be reasonably free-draining; otherwise rain falling on the open area will form a quagmire.

The Napierian-type stell not only has the advantage of sheltering from wind, rain and driven snow but it also lessens the problem of sheep being buried under drifting snow. The lack of natural shelter has been accentuated in some areas by failure to maintain shelter-belts and to replant those felled during the war. Low-cost shelters can bridge the gap until natural shelter can be re-established. Research work has shown that sheep are obviously affected by strong winds and on the higher land adequate shelter from wind and driven rain can be provided very cheaply by using simple shelter fences. Dry-stone walls in the shape of tees and crosses can still be seen on hill lands, and where stone is available on site this traditional construction is cheap and satisfactory.

A modern alternative is to erect a shelter fence using timber or steel posts covered with galvanized plain or corrugated steel sheeting. The shelter should not be less than 4 ft 6 in. high and should be finished with a top rail of 4 in. × 2 in. timber to prevent damage to the edge of the sheeting. The rail will also prevent the rubbing off of wool. The fence may have to withstand considerable lateral pressure from sheep and posts should be not less than 3 in. × 3 in. square timber (or equivalent round post) or steel angle-irons $1\frac{1}{2}$ in. × $1\frac{1}{2}$ in. × $\frac{1}{4}$ in. thick. Posts driven at least 1 ft 6 in. into the ground and spaced not further than 4 ft 6 in. apart will form an adequate framework for the 22-gauge sheeting. Fences arranged in a cross or tee shape have the advantage of providing shelter from all quarters but, like all solid barriers, they may be subject to drifts on the lee side in driven snow.

Shelters for hill cattle are of traditional building shape and, being taller than stells, are more susceptible to wind damage on exposed sites. A low-cost shelter can be built in round timber poles with a mono-pitch roof, enclosed on three sides with the front open or partly clad. To ensure a reasonable length of life the poles should be preserved and sunk at least 3 ft 6 in. into the ground; the back-filled earth should be well rammed down. The roof rakers must be selected with care bearing in mind the likely snow load the roof will have to carry. Wind pressures will also produce a loading on the roof, but fortunately strong winds will usually sweep away snow and limit the total load. The roof can be covered with metal roof sheets and should be securely tied to the main framework. Cladding can be of the same material or of timber, either solid or space-boarded.

There is an old adage that 'a dry back is worth an extra feed', and although this may be qualified in the light of modern research, more than a grain of truth remains to justify the provision of artificial shelter within the economic limits of the farming enterprise.

Books

Soils in Relation to Crop Growth. Firman E. Bear. Chapman and Hall, 1965. £5.

The field covered by this book is huge. It is described on the front flap as 'a broad semi-technical survey of soil science for biologists, botanists, conservationists, and farmers; a refresher course for soil chemists and technologists; a basic text for agriculture students'. The first half is on the origin and classification of soils; their chemical composition, physical properties and biological processes; soil air, soil water, the soil solution and organic matter; the mineral and water requirements of plants and soil factors affecting their growth; cultivations, drainage, irrigation and soil conservation. The second half deals with resources of nitrogen, phosphorus, potassium, calcium, magnesium, sodium, sulphur and the trace elements; some aspects of the fertilizer industry and the use of fertilizers; and ends with a chapter on yield potentialities of crops.

In a broad, semi-technical survey, a limited and rather superficial account of the subject is to be expected. In this book information is often too brief, and there is a general lack of references to original papers and other sources. The early chapters suffer particularly from brevity, and those on water requirements of plants and soil water are inadequate and not in keeping with ideas and experiments over the past ten years. The second half of the book gives much more information, which perhaps reflects the author's interests in soil science. There are many interesting statements and sections which readers would like to know more about, e.g., the statements 'the nature of the subsoil is often more important than the plow depth in determining the crop-producing power of the land' and 'a fair index of the relative productive capacities of a series of soils can be obtained by counting the number of live micro-organisms per unit weight of soil', and the sections on indexes of productivity and the mechanical management of soils.

The book is almost wholly about soils in the United States, which are more diverse and are often managed differently from soils in the U.K., but there is much that has application to soil conditions here. Soil scientists will find little in it that they do not know more fully; husbandry specialists and agronomists may find statements and information that have application to cultural practices; farmers should find the book readable and interesting. It will lead them to question the use of some soil treatments and their effects on crop production and soil fertility. It must be said, however, that at £5 the price seems too high.

N.H.P.

A History of Agricultural Science in Great Britain. Sir E. John Russell. Allen and Unwin, 1966. 63*s*.

Sir John Russell was born in October, 1872, and he finished writing this book only a few weeks before his death on 12th July, 1965. His name will always be closely associated with the Rothamsted Experimental Station. He worked there for thirty-six years and was its Director from 1912 to 1943, when he retired at the age of seventy. In this book of almost 500 pages he surveys agricultural science in Great Britain from 1620 to 1954, the year 1620 being the date of publication of Francis Bacon's *Novum Organum*. Bacon (1561–1626) was 'the first British scientist to concern himself with agriculture'.

Russell divides the history of agricultural science into four stages. The first, when science was entirely individual enterprise, lasted from the end of the sixteenth century to the end of the eighteenth century. The second began towards the end of the eighteenth century, when modern chemistry was beginning to emerge as the result of research by Lavoisier and others, with which a sound basis could be formed for the development of agricultural science.

The third period began towards the end of the nineteenth century, when Oxford University and others started university extension lectures in the counties. This activity led to a new type of research: institutional in general but personal and voluntary in character. The fourth period dates from 1909, when Mr. Lloyd George, as Chancellor of the Exchequer, set up the Development Commission, under whose

auspices 'a new type of research institute was to be created and a new profession: the full-time paid investigator in agricultural science'.

Russell's book is much more than a history of agricultural science. It tells us also about the scientists themselves and the institutions they helped to develop. It is full of interesting information and out of the way facts, such as the statement that Joseph Priestley, who discovered oxygen in 1774, earlier 'showed his ingenuity by inventing soda water, which won him the Copley Medal of the Royal Society: its highest award'.

The hero of the book, if a work such as this can be said to have a hero, is Sir Daniel Hall (1864–1942). Among the posts that he held during his long career were those of Principal of Wye College, Director of Rothamsted, Permanent Secretary to the Board of Agriculture and Fisheries, and Director of the John Innes Horticultural Institute. Russell's admiration and affection for Hall can be sensed in every mention of his achievements and qualities. Russell's own outstanding contribution to the development of agricultural science has to be gleaned largely from Sir Bernard Keen's foreword to the book.

H.G.B.

Saga of the Steam Plough. HAROLD BONNETT. Allen and Unwin, 1965. 42*s*.

This book is so full of information from fast disappearing sources that it could not fail to be a valuable contribution to the history of agricultural engineering. The fact that it has turned out also to be an entrancing book to read and enjoy, is due largely to the manner in which the material is arranged. Separate facets of the subject are treated in separate chapters, but within each chapter there is an easily-followed chronological order.

Some of the chapters look at a short period of development; an example is 'The Middle Period of Invention, 1834-54'. Others, such as 'The Direct Tractionist at Work', span longer periods. The chapters themselves are grouped more or less chronologically, the first one being 'The Years of Ideas' and the last 'Preservation Days'. Historians will find a ready-made source-note in the Appendix, 'Principal Ideas and Achievements Associated with Steam Cultivation, 1619–1860'.

The book is written in nostalgic vein, but sentiment is kept in check most of the time and in the first part of the chapter 'What was Wrong with Steam Ploughing?' the author gives some hard figures of costs. There are also some plain truths about the cultural effects of cable ploughing. It is interesting to discover that our present-day concern about soil compaction is no new thing; it seems that a two-horse team often used to go into action after steam ploughing, just to plough up the wheelings made when the engines were moved from one part of the field to another. At the end of this chapter, however, Mr. Bonnett admits to being glad that no very real attempts were made to improve the efficiency of agricultural steam engines, because he fears that the improvements in efficiency might have spoilt the balance of round shapes which gave them their good looks.

In a curious way this book on steam engines is a tribute also to their successful rivals, motor tractors, because it shows what an exacting task it has been to provide power in the field and transform it to tractive effort. It was easier to design implements than tractors. Implement designs can be fanciful, and there is scope for arguing about whether the ultimate effects of the cultivations performed will be good or bad. But a prime mover has to face an easily-assessed trial on whether it will travel over the field or come to an ignominious stop.

The author tells us that in a patent for some clever cultivators, taken out in 1810, it says that the implements described could be '. . . connected with wind, steam or other such like mechanical power which any ingenious workman will know how to do . . .'. This must have been the greatest overstatement of the nineteenth century. Mr. Bonnett's book describes the real task of some of those 'ingenious workmen', the manufacturers of steam engines and the colourful travelling crews who operated them with such great skill and charming flamboyance.

H.J.H.

Pigs: Their Breeding, Feeding and Management (9th Edition). V. C. FISHWICK. Crosby Lockwood, 1965. 25*s*.

This latest revision of a well-proved book on pig husbandry, originally published in 1939, has largely been undertaken by Norman Hicks of *The Farmer's Weekly*. His knowledge of commercial pig farming and, in particular, of its marketing aspects, are apparent from those

sections of the book for which he has been responsible.

The management of breeding stock to produce large, regular litters and the rearing of young pigs up to weaning are dealt with in detail. It is surprising, therefore, that only early weaning at 10–12 days of age should be discussed; this system has almost entirely been replaced by three-week early weaning, of which there is no mention. Compensation for this omission lies in the practical information on such items as creep feeding and sow management.

The economic production of baconers, porkers and heavy hogs, is covered with equal competence. Feeding is considered from two standpoints, the general principles and economic considerations. Most feeding systems are discussed and there is much of interest to the home-mixer. However, one expects to find copper mentioned as a growth stimulant, but comment is confined to the use of antibiotics in this role. Similarly, reference is made to the 'animal protein factor' and yet the amino-acids are neglected. Throughout this husbandry section there is emphasis on the need for proper records, with examples which provide for both simplicity and ease of interpretation.

The section on housing contains useful information on siting, design and construction, with reference to materials and environmental control. There are also 14 loose-leaf housing plans showing various designs of both breeding and feeding accommodation.

In a work of this sort, aimed at the commercial producer, it is understandable that disease should be discussed in terms of prevention rather than cure. The author has justifiably concentrated on those aspects which are most commonly encountered and at the same time are within the producer's control.

The remainder of the book deals admirably with the establishment of a pig enterprise on various types of farm and its development as a profitable unit, concluding with an informed comment on marketing and the industry as a whole.

The book is well illustrated and easily understood and has a good deal to interest both the newcomer to pig farming and the producer of long standing. Since it is said to have been 'entirely revised and brought up-to-date', however, one is entitled to expect more attention to be paid to new developments in the husbandry field and the application of recent research.

G.A.M.

Principles of Estate Management. MICHAEL THORNCROFT. The Estates Gazette, 1965. 47*s*. 6*d*.

Described as a result of research carried out at the College of Estate Management and primarily written as a text-book, this book carries a foreword by a Senior Vice-President, now the President, of the Royal Institution of Chartered Surveyors. He explains that its origin lay in a recommendation that there should be one comprehensive book demonstrating the interrelation in particular of valuation, economics, town planning law and building construction.

No small task this, and the author can be congratulated on succeeding in the object he has set himself. He has produced a long work setting out in general terms the principles of what he calls 'national estate management', a phrase by which Mr. Thorncroft describes the proper and competent management of both urban and rural land. The book is hardly for the general reader, nor is it of special interest to the agriculturist, but it is a timely and adequate statement of the general principles underlying the best professional practice of those qualified to manage town and country properties.

Certainly when local and central government so often do things which affect interests in land, it can only do good to attempt to describe the complexity of those interests and the many different aspects of their management from both the public authority's and the private person's point of view. The book deserves to be well received by the landed profession and others concerned with planning and land law.

R.G.A.L.

Insecticide and Fungicide Handbook (2nd Edition). Edited by H. MARTIN. Blackwell Scientific Publications, 1965. 32*s*. 6*d*.

The issue of the second edition of this most useful book testifies to its popularity. In the same format, it is produced at nearly the same price as the 1963 edition, although it contains twenty extra pages.

For those who do not already know this valuable work, it must be explained at once that it is a complete guide to the use of insecticides and weed-killers in the United Kingdom and is an essential tool for anyone using these products. Moreover, it is edited by the leading expert in this field.

The emphasis, naturally, is on pest control by chemicals: other methods, such as biological control, have the same short mention as before, but the dread words 'integrated control' that *bête noir* of the pesticide user, nowhere occur. This is a pity, for integrated control is much in the air today.

Those who already know the work will be interested in the changes made in this edition. The introduction ('The biological background') is much the same, as is the next chapter on the chemical background. The main changes are the inclusion of some thirty new compounds; that is new to the book, for some of the newcomers are old remedies such as carbon tetrachloride, liver of sulphur and paradichlorbenzene. Nevertheless, it is good to have details of these substances in such an important reference work. One product, heptachlor, has been dropped.

In the section on pests, the seriousness of the pest is indicated by a system of stars, running from zero to three, as before. Of course, as in labelling brandy, it is difficult to make such ratings, and the book claims no infallibility in this respect. It is interesting to notice how the stars have risen and declined, since this indicates what the pest status now is. For instance, in cereals, the wheat shoot beetle, leaf spot, barley aphid and loose smut are down a star, whilst wheat bulb fly, scab, mildew, oat eelworm, frit fly, leather-jackets and wireworm are all raised one star. I notice that slugs in potatoes are still rated a two-star pest.

The useful dilution table in Appendix II of the first edition has been omitted, but the work is not meant for field use so perhaps this does not matter.

G.O.

The Daffodil and Tulip Year Book 1966. Royal Horticultural Society. 15*s.* (by post 17*s.*)

Herrick mourned the brevity of the daffodil season; modern devotees compensate for the short spring by discussing their favourite flower throughout the year. This book is a distillation of such daffodil talk, and once again the editors must be congratulated on their collection of articles which are fresh, interesting and useful.

Inevitably, perhaps, show daffodils and daffodil shows have pride of place, approximately one-third of the year book being allotted to these, but the world-wide coverage provides interesting comparisons and the account of west of England shows from the accomplished pen of that gentle connoisseur, Mr. Alec Gray, is again a model of show reporting.

While keen exhibitors will be absorbed in reading who won, where and with which varieties, the general reader will be more attracted by some other chapters such as the naturalizing techniques followed at Windsor; 1965 as a vintage year for miniatures; and a survey of modern reverse bicolors. The latter, by Michael Jefferson-Brown, proves that the new generation of daffodil enthusiasts, the third since daffodils sprang into popularity in the 1870s, is now firmly in the saddle.

This year there is a welcome strengthening of the scientific contributions, both in quantity and quality; that by J. J. Hesling on narcissus eelworm is outstanding. He shows the importance of this menace by pointing out that more acres of narcissi are grown in the U.K. than in any other country of the world and that our bulb industry is valued, conservatively, at £12 million per annum.

Tulips occupy a minor position in the year book, as befits their lesser popularity, but the accounts of cottage tulips and old tulips in Holland are particularly interesting. Notes on Hippeastrums and Sternbergias are included for good measure in the general mixture of ingredients.

This is an essential reference book for those professionally associated with daffodils and pleasant fireside reading for everyone waiting impatiently for the 'sweet of the year'.

K.H.J.

Bird Watching. PETER CLARKE. George Newnes, 1965. 10*s.* 6*d.*

This beginner's guide is divided into four parts or chapters. The first is largely introductory, dealing with why people watch birds, the advantages of joining one or other of the local or national bird societies, and advocating a code of good behaviour for bird watchers.

Part 2, entitled 'How to Watch', adequately explains how to choose binoculars and telescopes. But it is not so forthcoming on books (only three are mentioned) and there is no bibliography. A very brief section on classification gives the principles of scientific nomenclature. Here it is unfortunate that, as there are only two examples of scientific bird names in the whole book, the Latin

name for the American robin should have been mis-spelt *Turdus migratori(o)us*.

Most of this chapter is devoted to the identification of birds and the use of the field note-book, and it contains some useful information and advice. There are descriptions of a number of birds, with realistic drawings by R. A. Richardson, both here and later in the book. The chapter also includes a selection of suggested studies, some of which are very similar to those in an earlier work by a different author, and some hints on the care of sick birds.

Part 3, 'When to Watch', discusses the terminology commonly used to describe the status and distribution of a species. There is a small section on migration and ringing, followed by a review of bird life through the seasons.

The last part, 'Where to Watch', considers ways of attracting birds to gardens and deals with birds found in different types of country. The work of the bird observatories is described and nature reserves and field centres are mentioned. The chapter ends with a list of these places of study and natural history museums, to help the novice discover good bird-watching localities. A more comprehensive and informative list can, however, be found in a popular book on bird watching published two years ago.

Some statements in the book are open to doubt. Is it true, for instance, that the great spotted woodpecker drums on hollow trees or rotten tree trunks? Other terms would benefit from amplification or elucidation. For example, barbules are referred to but not described and these, together with emargination of feathers and the construction of hides and Heligoland traps, could profitably have been illustrated by simple drawings.

Despite these criticisms, the beginner should find this book of considerable interest.

T.B.

A Bibliography of Farm Buildings Research. Part IV—Buildings for Cattle. 2nd Supplement, 1962–64. Agricultural Research Council. 12*s*.

This bibliography goes from strength to strength, as the 465 references in this supplement testify. Cattle buildings in this country represent a huge capital investment. Add to this the influence for good or ill which a livestock building has upon the performance of the inmates, human as well as animal, and the vital nature of research work in this field comes into perspective.

Milch cows are an immensely important part of farming systems in many different countries and so it is hardly surprising that they figure prominently in research studies. These studies, from all over the world, emphasize that cows just cannot function efficiently in high temperatures and high humidities. But they can and do maintain output and condition in low temperatures; 65°F seems the right maximum. Normal winter temperatures in this country are well within recorded 'lows'. Cows in Saskatchewan, Canada, did not decrease their milk yield even when temperatures fluctuated as low as minus 30°F (62° of frost).

The references to loose housing quote alarmingly wide figures for bedding usage in cubicles, ranging from 12 lb of sawdust per month to 60 lb in the same period. Usage of straw in bedding also shows a wide range of quantity.

Two references attributed to the West of Scotland Agricultural College are out of accord with one another. The first records that in a cubicle housing system affording one cubicle per cow, peak use of the cubicles occurred in the early morning when nearly all of them were occupied. Otherwise cubicles were occupied for about 55 per cent of the time. The second suggests that a ratio of 105 cubicles per 100 cows is needed for herds exceeding 40 cows. If the first reference is believed, there seems no reason to provide even 100 per cent of apparent need, much less 105 per cent.

Why do farmers give up milk selling? Because of bad buildings, says a Milk Marketing Board report; because of the seven-day working week, says a report attributed to Newcastle University. For my money the University has the right answer.

This is a very useful publication for the farmer and a 'must' for those in the advisory or research fields. A pity the price has gone so high.

C.R.

Books Received

Specific Replant Diseases. Research Review No. 1, Commonwealth Bureau of Horticulture and Plantation Crops. B. M. Savory. Commonwealth Agricultural Bureaux, Farnham Royal, Bucks, 1966. 15*s*.

Land and People. The countryside for use and leisure. B.B.C. Publications, 1966. 6*s*.

Agricultural Chemicals Approval Scheme

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The following changes of company addresses, etc., are also announced:

Agricultural Services Ltd. have changed their address to Eddington, Hungerford, Berks. (Hungerford 606).

Baywood Chemicals Ltd. are now at Eastern Way, Bury St. Edmunds, Suffolk. (Bury St. Edmunds 2041).

Mirvale Chemical Co. Ltd. have changed their telephone number to Mirfield 3861-6.

Inquiries on Plant Protection Ltd. products should now be made to Plant Protection Ltd., I.C.I. Agricultural Division, Fernhurst, Haslemere, Surrey. (Haslemere 4061).

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OFFICIAL APPOINTMENTS

AGRICULTURAL ECONOMIST

MALAYSIA

Required to advise the Ministry of Agriculture and Co-operatives on the policies and methods to be adopted to increase and improve the net returns of small producers in rural areas with the view of increasing their purchasing power and to diversify the agricultural economy of the country, and train local counterparts and establish firmly an Agricultural Economics Section.

Candidates should hold a degree in Agricultural Economics with preferably a Higher degree qualification. Preference will be given to candidates over the age of 40 who have had wide experience of tropical crops.

Salary £3,250 a year, subject to British income tax, plus a variable, tax-free, foreign service allowance ranging from £445 to £1,395 a year according to marital status. Contract post for two years. Passages provided. Education allowances. Quarters provided. Medical attention to N.H.S. standard.

Candidates, who should be nationals of U.K. or the Republic of Ireland, should write for further details, giving full name and brief particulars of qualifications and experience quoting RC 213/106/06 to:

Appointments Officer,
Room 301,
MINISTRY OF OVERSEAS DEVELOPMENT,
Eland House, Stag Place,
London, S.W.1.

DIRECTOR OF AGRICULTURE

BAHAMAS

Duties: To advise on all aspects of Agricultural Development and on legislation to implement policies.

Qualifications: Candidates who should be between 40 and 55 years of age, must hold a degree in Agriculture or Agricultural Science with a Post-graduate Diploma in Agriculture or Tropical Agriculture and have considerable experience in the tropics and in the organisation and administration of a large department.

Salary: £3,800 per annum plus an allowance of 5% of salary plus gratuity of 15% of basic salary. Contract appointment for three years. Passages provided. No local income tax.

Applicants, who should be nationals of the United Kingdom or Republic of Ireland, should write for further details, giving full name and brief particulars of qualifications and experience quoting RC 213/14/06 to:

Appointments Officer,
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MINISTRY OF OVERSEAS DEVELOPMENT,
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OFFICIAL APPOINTMENT

NIGERIA

The GOVERNMENT OF NORTHERN NIGERIA invites applications for the following vacancies in the Ministry of Agriculture. APPOINTMENTS made on CONTRACT BASIS for two tours of from 18–24 months each in the first instance.

I. **Agricultural Officers:** Applicants must possess degree in Agriculture or Horticulture plus at least two years' post-graduate training. *Salary* from £1,206—£2,202 p.a. according to post-qualification experience. Those with higher qualifications and many years experience may be appointed as SENIOR or PRINCIPAL AGRICULTURAL OFFICERS. *Salary* from £2,376—£2,532 p.a. according to post-graduate experience.

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III. **Specialist Superintendent (Horticulture):** Candidates should have degree in Horticulture *or* have completed recognised course or Diploma in Horticulture, *or* have had approved horticultural experience. *Salary* from £942—£2,046 p.a.

IV. **Agricultural Superintendent (Mechanical):** Applicants should have had three years' experience in a Mechanical Engineering Works and have had experience of all types of agricultural tractors and implements. *Salary* from £906—£1,926 p.a.

V. **Agricultural Superintendent (Soil Survey):** Applicants must have degree in Agriculture, Geography, Geology, Soil Chemistry or Botany with geological bias. *Salary* from £942—£2,046 p.a.

VI. **Fisheries Superintendent:** Applicants should have successfully completed a recognised Fisheries Course or have approved experience in FISHING INDUSTRY. *Salary* from £906—£1,926 p.a.

VII. **Fisheries Officer:** Applicants must have degree in Biology with emphasis on Zoology, preferably including some work on fish. *Salary* from £1,104—£2,202 p.a.

VIII. **Irrigation Engineers:** Candidates must have degree in Civil Engineering plus at least five years post-graduate experience in this field. *Salary* from £1,104—£1,878 p.a.

IX. **Agricultural Engineers:** Applicants must possess B.Sc. Agriculture Engineering or B.Sc. Agriculture with diploma in Agricultural Engineering. A.M.I.Mech.E. with agricultural experience or A.M.I.C.E. with mechanical bias including agricultural experience would also be acceptable. *Salary* from £1,104—£2,202 p.a. Those with higher qualifications and many years' experience may be appointed as SENIOR AGRICULTURAL ENGINEERS. *Salary* from £1,944—£2,568 p.a.

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Further information and application forms can be obtained from:

The Recruitment Officer,
Northern Nigeria Recruiting Agency,
Nigeria House, 9 Northumberland Avenue,
London, W.C.2.

OFFICIAL APPOINTMENTS

Director, CENTO Agricultural Machinery and Soil Conservation Training Centre

KARAJ, IRAN

Duties: To be responsible for seeing that basic theoretical and practical training is given in: (i) The operation and maintenance of agricultural machinery suitable for use in the CENTO region: (ii) Soil Conservation, irrigation techniques and farm surveying; to control such funds as are allocated to the Centre and to maintain the necessary accounts.

Qualifications: Candidates should hold a B.Sc.(Eng.) or an A.M.I.Ag.Eng., or a degree in agriculture with special training or experience in soil conservation. Preference will be given to a candidate with a higher degree. Practical knowledge of farm machinery or of soil conservation and administrative experience with ability to lecture are essential.

Salary in the range £3,500 to £3,800 a year, subject to British income tax, plus a variable non-taxable foreign service allowance of £525 (single), £900 (married unaccompanied) or £1,085 (married accompanied) a year. Entertainment allowance £250 p.a. Education allowances. Passages provided. Quarters available. Two-year contract.

Candidates, who should be nationals of the United Kingdom or the Republic of Ireland, should write for further details giving full name and brief particulars of qualifications and experience, quoting RC213/86/06 to:

Appointments Officer,
Room 301,
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Livestock Improvement Officer, Kenya. Applications are invited for the post of Livestock Improvement Officer to supervise the breeding programme of the National (Sahiwal) stud and to carry out field trials and research in nutrition and management under the direction of the Chief Veterinary Research Officer. Candidates who should normally be nationals of the United Kingdom or Republic of Ireland should possess a Degree in Veterinary Science or an honours degree in Agriculture, with extensive experience in livestock breeding and animal husbandry. Salary in scale £1,374 to £2,757 per annum (Entry point determined by qualifications and experience), plus 25% terminal gratuity. Free passages. Quarters available. Two-year contract. Please apply for further details giving full name, qualifications, experience and quoting Ref. RC 217/95/012, to Appointments Officer, Ministry of Overseas Development, Room 301, Eland House, Stag Place, London, S.W.1.

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MALAYSIA

DIRECTOR, TECHNICAL OPERATIONS DEPT.

Duties: To plan and prepare all project proposals of F.L.D.A.; to determine scope of agricultural research and work required for agricultural development and land settlement.

Qualifications: B.Sc. (preferably D.Sc.) in Agricultural Science, with wide experience in planning and execution of large scale agricultural projects for land reform or resettlement. Previous experience with International Agencies an advantage.

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OFFICIAL APPOINTMENTS

CHIEF AGRICULTURAL OFFICER
MID-WESTERN NIGERIA

Required to administer the Agricultural Services Division of the Ministry of Agriculture and Natural Resources in Mid-Western Nigeria and to be chief professional adviser to the Minister on all agricultural matters.

Candidates should be trained agriculturists with a degree in pure science, agriculture or horticulture plus considerable practical experience in tropical agriculture.

Salary range £2,500 to £3,000 a year, subject to British income tax, plus a variable tax-free overseas allowance of £730 (single) or £1,330 (married, unaccompanied) or £1,535 (married accompanied) a year.

Passages and accommodation provided. Educational allowances. Free medical and dental treatment.

Contract appointment for one tour of two years in the first instance.

Candidates, who should be nationals of the United Kingdom or the Republic of Ireland, should write, giving full name and brief particulars of qualifications and experience, quoting RC 213/200/01 to:

Appointments Officer,
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Ministry of Overseas Development,
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CHIEF
RESEARCH OFFICER
GHANA

Required to be in charge of the plant breeding section of the Crops Research Institute, Kwadaso, near Kumasi.

Candidates should have a higher degree in plant genetics, plus considerable experience in plant breeding. Tropical plant breeding and genetics experience desirable.

Salary range £2,500—£3,000 a year subject to British income tax, plus a tax-free overseas allowance of either £920 (single), £1,510 (married unaccompanied) or £1,830 (married accompanied) a year. Passages provided. Government quarters. Education allowances. Three-year contract.

Candidates, who should be nationals of the United Kingdom or the Republic of Ireland, should write for further details giving full name and brief particulars of qualifications and experience, quoting RC 213/70/02, to:

Appointments Officer,
Room 301,
Ministry of Overseas Development,
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LECTURER IN SOIL CONSERVATION
IRAN

Required to lecture on soil conservation and irrigation techniques to post-graduate students from the CENTO countries.

Candidates should hold a degree in agricultural engineering or in soil conservation, or a degree in civil engineering and soil conservation. Practical experience of soil conservation and irrigation techniques is desirable.

Salary £2,100 to £2,500 a year (according to qualifications and experience) subject to British income tax, plus a variable non-taxable foreign service allowance of £525 (single) £820—£900 (married unaccompanied) and £970—£1,085 (married accompanied) a year. Education allowances. Passages provided. Quarters available. Two-year contract.

Candidates, who should be nationals of the United Kingdom or the Republic of Ireland, should write for further details giving full name and brief particulars of qualifications and experience, quoting ref. RC.213/86/08 to:

Appointments Officer,
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